Service Manual

FILE No.

Ultra-Low Temperature Freezer

MDF-U33V
MDF-U32V(N)

SANYO Electric Co., Ltd.
Biomedical Business Division

RoHS

This product does not contain any hazardous substances prohibited by the RoHS Directive.
(You will find 'RSF' mark near the rating plate on the RoHS compliant product.)

WARNING

* You are requested to use RoHS compliant parts for maintenance or repair.
* You are requested to use lead-free solder.

SM9910135

Effective models

This service manual is effective following models.

Model name	Product code	Voltage and Frequency	
MDF-U33V	823 003 51	115V	60Hz
	823 003 52	220V	50Hz
	823 003 53	220V	60Hz
	823 003 54	230/240V	50Hz
MDF-U32V(N)	823 003 55	220V	50Hz

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Warming up operation at low ambient temperature

Note: The descriptions are effective for the units in the area of 110 ~ 115V/60Hz only.

When the unit starts running in the low ambient temperature, it occasionally causes the Low side compressor being inoperative. Warming-up operation is needed to start the Low side compressor without fail. The unit should be cycle operated to stop both low side compressor and high side compressor running.

1. Warming-up operation

Warming-up operation activates when the unit starts at low ambient temperature (e.g. 25℃ or lower).

<Operation sequence>

(1) Turn the power switch 'ON'.
(2) The High side compressor starts running after 3 minutes elapses.
(3) The High side compressor keeps running for 3 minutes and stops when the cascade temperature is reached to -34℃.
(4) After 10 seconds elapse, the Low side compressor should be turned on.
(5) The Low side compressor is energized for 20 seconds and stops for 3 minutes.
Frequency to repeat '20 seconds ON and 3 minutes OFF' is depend on the ambient temperature.

AT (AT sensor temperature in F15)	Frequency to repeat '20 seconds ON and 3 minutes OFF'
Lower than +5℃	14
+5℃ ~ +14℃	9
+15℃ ~ +24℃	6
Higher than +25℃	None
AT sensor open or short circuited	9

(6) When the unit completes 'ON and OFF' action, High side compressor starts after 3 minutes elapse since the Low side compressor stops, and the Low side compressor starts again when the cascade sensor temperature is reached to -34℃.

2. Compressor operation once the chamber temperature is reached to set temperature

(1) The chamber temperature should be controlled by turning both the Low and High side compressor ON/OFF.
(2) When the chamber temperature is set temperature -1.6℃, both the Low and High side compressor should be turned OFF.
(3) When the chamber temperature is set temperature -0.4℃ after 3 minutes elapse since the Low and High side compressor turns OFF, the High side compressor should be solely turned ON.
(4) When the cascade sensor temperature is -34℃ after 1 minute elapse since the High side compressor turns ON, the Low side compressor should be turned ON.

3. Compressor operation retrieves from momentary power failure or power switch turned off

(1) In the momentary power failure or power switch turned off or set temperature is changed from -80℃ to -70℃ with battery switch is ON;
<a> When the Low side compressor OFF time is equal or more than 120 minutes, the Low side compressor should start with warming-up operation.
<b> When the Low side compressor OFF time is less than 120 minutes, the Low side compressor should start with normal operation in any ambient temperature.
(2) In momentary power failure within 3 seconds, the unit should start operation according with chapter 1. when display temperature is equal or more than set temperature + 10℃.

- The unit should start operation according with the chapter 1. when the battery switch is OFF.

4. Reactor and breaker

(1) Adjust frequency switch to your adequate frequency to use the reactor which restricts starting voltage in compressor. Make sure frequency switch should be adjusted correctly with power supply frequency to start compressor operation correctly.
Frequency switch is located at the rear on the bottom.
(2) Arrange the outlet breaker (refer to Recommended breaker), because compressor should be energized with 30A for 20 seconds continuously during warming-up operation.
<Recommended breaker>
Motor protection: More than 15A Line protection: More than 30A

Specifications

■Structural specifications

Item	MDF-U33V / MDF-U32V(N)
Name	Ultra-low Temperature Freezer
External dimensions	W670 × D867 × H1860 (mm)
Internal dimensions	W490 × D600 × H1140 (mm)
Effective capacity	333 L
Outer door	1 door, painted steel
Inner door	2 doors, ABS resin panel with stainless frame
Insulation	Vacuum insulation panel + rigid polyurethane foamed-in place
Exterior	Painted steel
Interior	Painted steel
Shelf	3 shelves (adjustable), stainless steel W464 x D535 (mm)　Load; 50kg/shelf
Outer door latch	1 pc
Outer door lock	1 pc
Access port	2 places (back, bottom left corner)　inner diameter; φ17mm
Refrigeration circuit	Secondary cooling system
Compressor	High stage side; Hermetic type, Output; 450W Low stage side; Hermetic type, Output; 750W
Evaporator	Tube on sheet type
Condenser	High stage side; Fin and tube type Low stage side; Shell and tube type
Refrigerant	High stage side; R-404A Low stage side; R-508
Refrigerant oil	Ze-NIUS32SA or Ze-NIUSL22SA
Power supply	Local voltage
Battery	Nickel-metal-hydride battery, DC 6V, 1100mAh, Auto recharge
Weight	255 Kg
Accessories	1 set of key, 1 scraper
Optional component	Automatic temperature recorder (MTR-G85, MTR-85H+MDF-S3085(Mounting kit)) Back-up system (CVK-UB2); LCO2 Inventory rack (IR-216U, IR-220U) 3 drawers for lower compartment (MDF-30R) Interface board (MTR-480)

■Control specifications

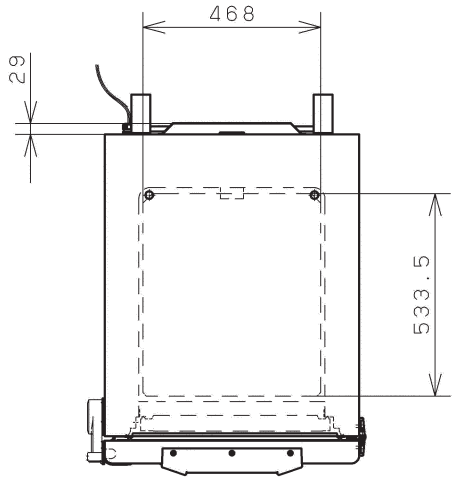
Item		MDF-U33V / MDF-U32V(N)
Temp. controller		Microcomputer control system Temperature setting range: -50℃～-90℃ (Unit: 1℃) Non-volatile memory
Thermal sensor		Pt.1000Ω
Temperature display		LED digital display
Alarms	Temperature	+5℃~+20℃ for High temperature alarm (Initial; +10℃) -5℃~-20℃ for Low temperature alarm (Initial; -10℃) ALARM lamp blinks and buzzer sounds intermittently with 15min. delay Remote alarm contact; Normal Open, Normal Close Allowable contact capacity; Max. 30VDC, 2A
	Door	DOOR lamp is lit with 2min. delay (Initial; 2min.) Buzzer delay time is changeable within 2 ~ 15min.
	Filter check	FILTER lamp blinks and buzzer sounds intermittently
	Power failure	ALARM lamp blinks, buzzer sounds intermittently and remote alarm is output.
	Remote alarm	Remote alarm terminal 3P; DC30V、2A NC-COM, NO-COM
	Battery check	BATTERY lamp is lit when battery accumulation time is approx. 3 years
	Fan motor check	Battery lamp blinks when fan motor accumulation time is approx. 6 years
Freezer status monitor		Status 1: Abnormal ambient temperature (When the ambient temperature is over than 35℃ or lower than 0℃） Status 2: Abnormal low voltage (When the power supply voltage is 15% less than the rated voltage) Status 3: Overloaded run（When the running rate of compressor (L) is over than 95%）
Control panel		Lamps: ALARM, BATTERY, STATUS, DOOR, FILTER Buzzer key: BUZZER Alarm test key: ALARM TEST Status key: STATUS Set key: SET Digit shift key: ⏩ Numerical value shift key: ⏫
Key lock function		Press ⏩key for 5 seconds to display; L0: Key lock OFF L1: Key lock ON
Self diagnosis		When any failure is occurred in sensor among temp. sensor, filter sensor, cascade sensor and AT sensor; ● Error code and chamber temperature are displayed alternately ● ALARM lamp blinks ● Remote alarm activates ● Buzzer sounds intermittently
Compressor protection		When the cascade sensor temperature is lower than -34℃, Low side compressor is turned on. When the cascade sensor temperature is higher than -18℃, Low side compressor is turned off. When the filter sensor is higher than +60℃, High side compressor is turned off. Overload relay for Low side compressor, Internal thermometer for High side compressor

■Performance specifications

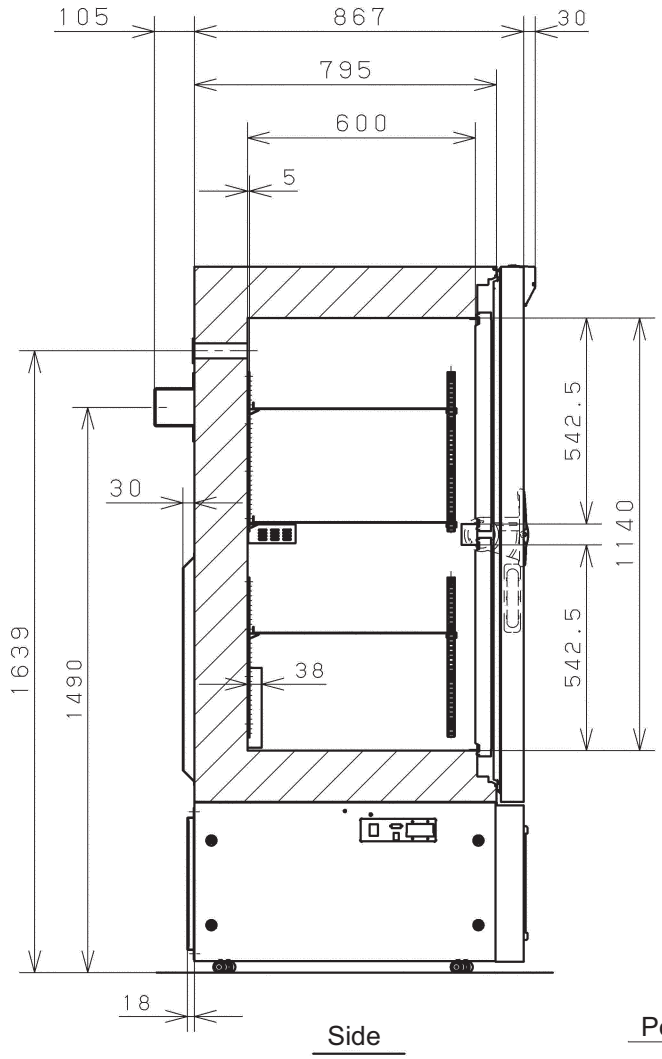
Cooling performance	-86℃ at the center of the chamber (AT30℃, no load)				
Temperature control range	-50℃～-86℃（AT30℃, no load）				
Power source	115V, 60Hz	220V, 50Hz	220V, 60Hz	230V, 50Hz	240V, 50Hz
Rated power consumption	775 W	640 W	710 W	610 W	650 W
Noise level	49 dB {A} (background noise 20dB)				
Maximum pressure	1.9 MPa				
Usable conditions	AT; +5℃~+30℃ Humidity: Less than 80％RH				

* Design or specifications will be subject to change without notice.

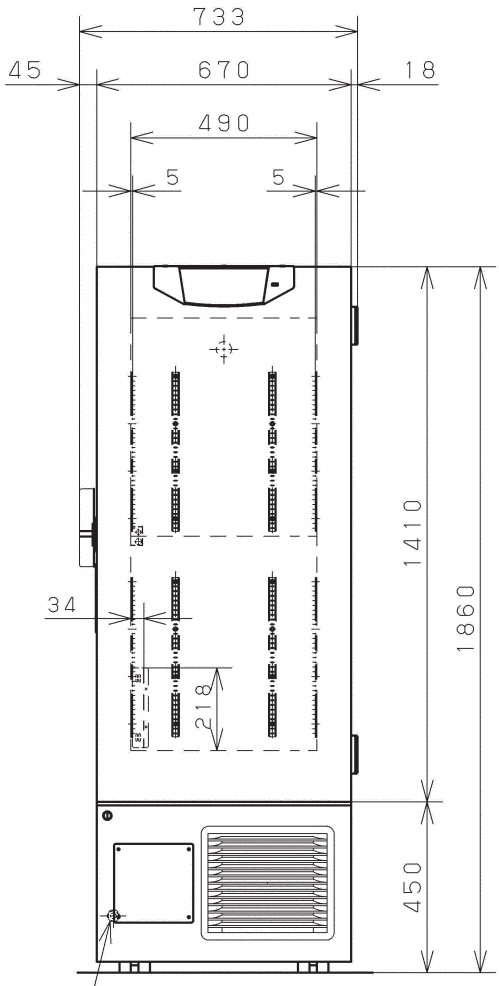
Dimensions



Ceiling



Side



Power cord

Front

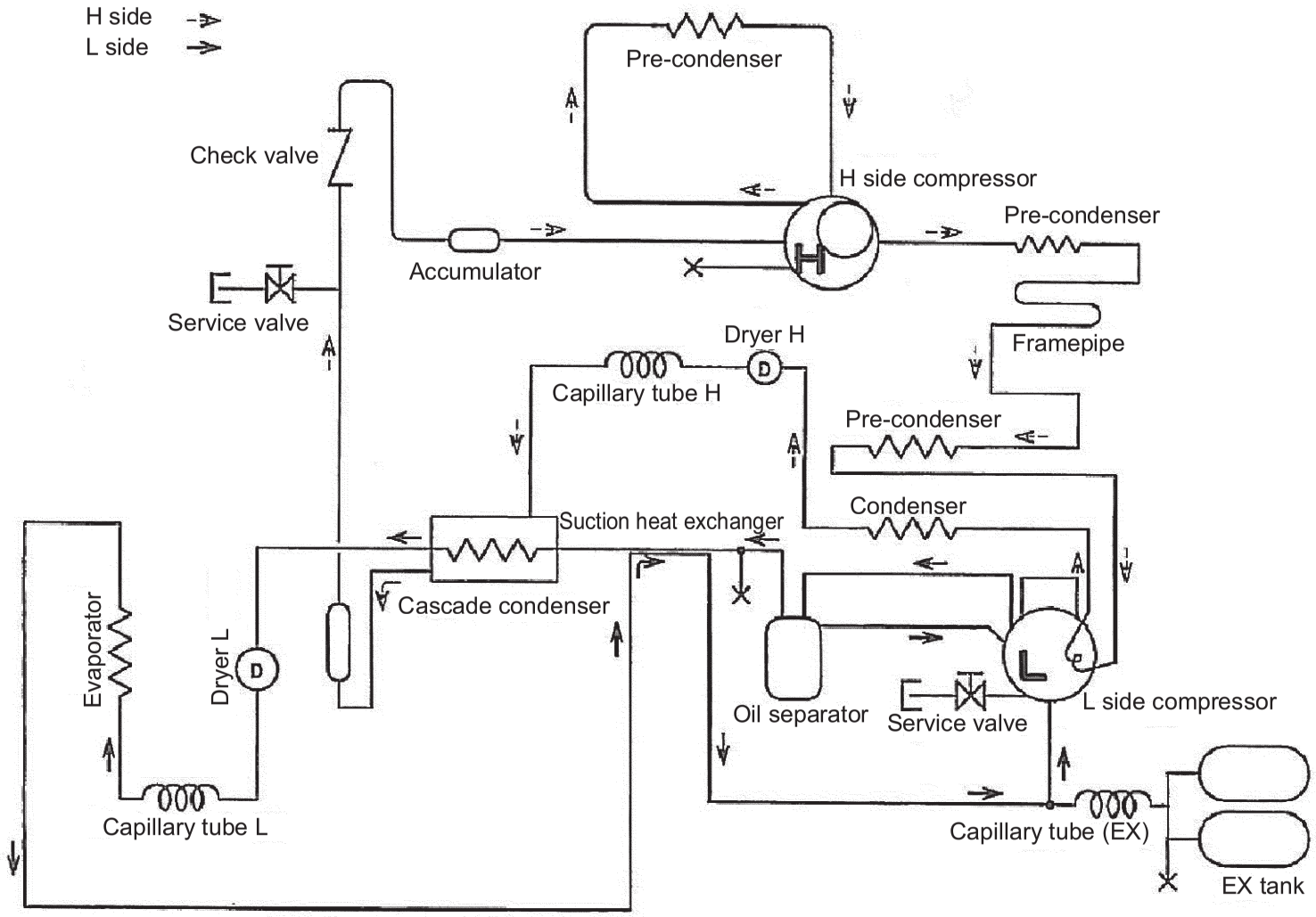
Cooling unit parts

<MDF-U33V/U32V(N)>

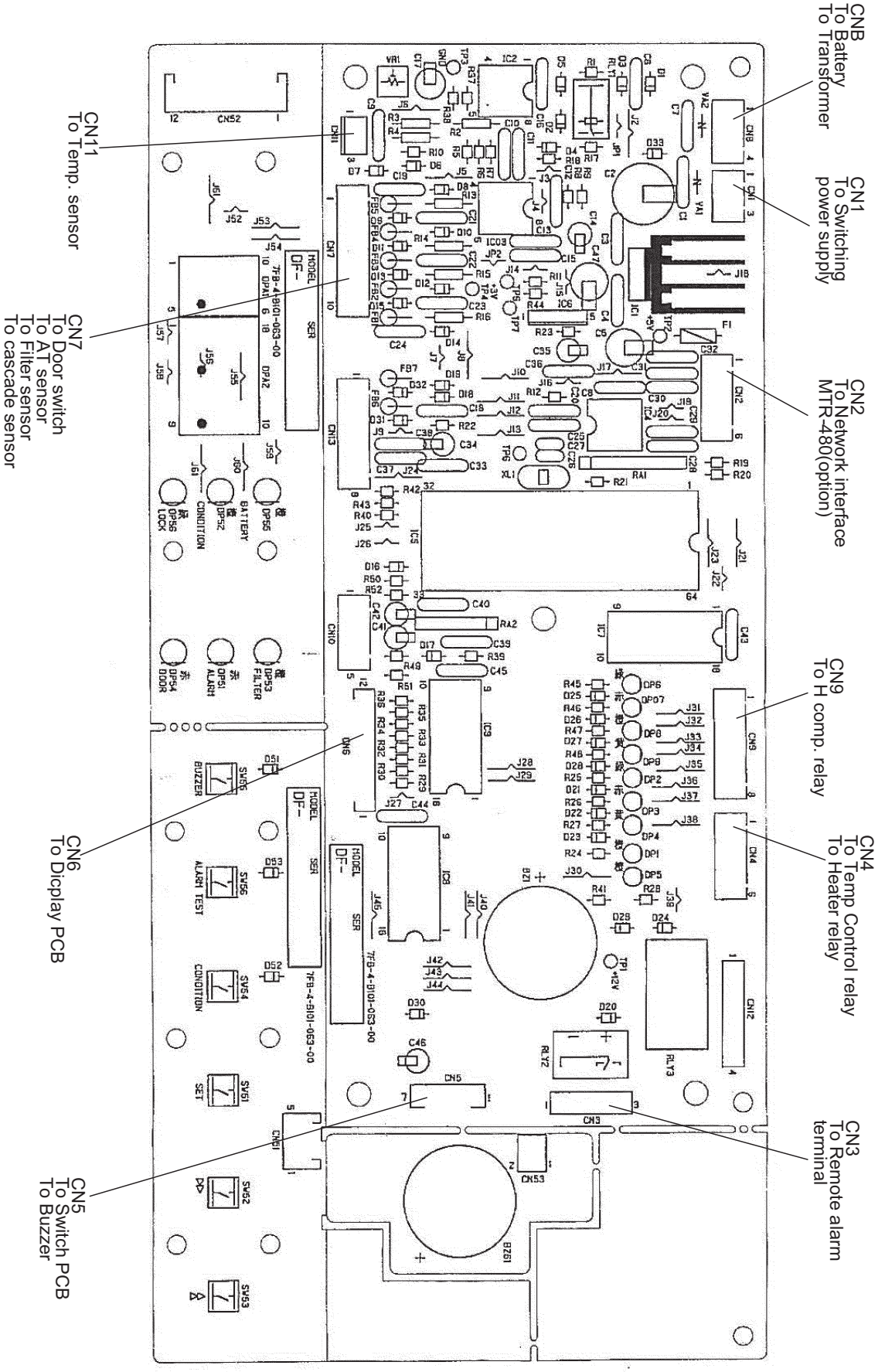
Item	Specifications		
	H side	L side	
Compressor			
115V,60Hz	Type:C-1RN45L1A Code:802 021 11	Type:CS200J1NS-1A Code:7FB-0-M101-002-02	
220V,50/60Hz	Type:C-1RN45L5A Code:812 022 15	Type:KS200J1NS-4A Code:7FB-0-M101-002-04	
230/240V,50Hz	Type:C-1RN45L5A Code:812 022 15	Type:KS200J1NS-4A1 Code:7FB-0-M101-002-05	
Refrigerant oil	Ze-NIUS22SA or Ze-NIUS32SA Charged q'ty: 230cc	Ze-NIUS22SA or Ze-NIUS32SA Charged q'ty: 850cc	
Cooling system	Forced air cooling（partially） DSH	Forced air cooling（partially） Oil cooler	
Condenser			
Type	Fin and tube	Cascade condenser	
Condenser	12 columns x 3 lines P6.35mm Fin 38pcs.	Coil pipe φ6.35mm	
Pre-condenser	W 250mm	——	
Frame pipe	φ4.76mm	——	
Evaporator Type	Cascade condenser Shell and tube φ80mm	Tube on sheet φ7.94mm	
Capillary tube			Ex.tank capillary
Resistance	0.363Mpa	0.363Mpa	34 PSI
Length	3000mm	3000mm	500mm
Outer diameter	φ2.0mm	φ2.0mm	φ2.4mm
Inner diameter	φ0.9mm	(φ0.9mm)	φ1.2mm
Refrigerant	R-404A Charged q'ty: 509g	R-508 Charged q'ty: 195g	
Oil additive	n-Pentane Charged-q'ty: 21g	n-Pentane Charged q'ty: 28g	
Dryer	Dry core Type: D-SM032T	4A-XH-6 Charged q'ty: 58g	
Condensing fan	φ230 mm、4 blades Material: ABS		
Condensing fan motor Type	115V SE4-E11L1P Output::10W 220～240V SE4-E11L5P Output:10W		
Oil separator	——	SPK-0S02S2 (810-4-2008)	

Refrigeration Circuits

Secondary refrigeration circuits



Components on PCB



Electrical Parts

MDF-U33V/U32V(N)		AC115V,60Hz	AC220V,50Hz	AC230/240V,50Hz	AC220V,60Hz
Compressor (H)	Type	C-1RN45L1A	C-1RN45L5A	C-1RN45L5A	C-1RN45L5A
	Code	802 0 2111	812 0 2215	812 0 2215	812 0 2215
	Rated voltage (50/60Hz)	115V, 60Hz	220-240V, 50Hz	220-240V, 50Hz	220-240V, 50Hz
	Winding resistance C-S(Aux)	2.739Ω	14.76Ω	14.76Ω	14.76Ω
	C-R(Main)	1.330Ω	5.95Ω	5.95Ω	5.95Ω
Starting relay (H)	Type	AMVL-165	AMVL-300A	AMVL-300A	AMVL-300A
	Pick up voltage				
	Drop out voltage				
Starting capacitor (H)	Rating	100μF, 160V	40μF, 300V	40μF, 300V	40μF, 300V
Running capacitor (H)	Rating	40μF, 260V	12μF, 300V	12μF, 370V	12μF, 370V
Condensing fan motor	Type	SE4-E11L1P	SE4-E11L5P	SE4-E11L5P	SE4-E11L5P
	Rating	115VAC, 10W	220-240VAC	220-240VAC	220-240VAC
	Thermal fuse				
Compressor (L)	Type	CS200J1NS-1A	KS200J1NS-4A	KS200J1NS-4A1	KS200J1NS-7A
	Code	7FB-0-M101-002-02	7FB-0-M101-002-04	7FB-0-M101-002-05	7FB-0-M101-002-06
	Rated voltage (50/60Hz)	115V, 60Hz	220/230V, 50Hz	230/240V, 50Hz	220/230V, 60Hz
	Winding resistance C-S(Aux)	3.18Ω	4.6Ω	4.7Ω	4.3Ω
	C-R(Main)	0.64Ω	2.1Ω	2.7Ω	1.7Ω
Starting relay (L)	Type	AMVL-155BF	AMVL-300TA	AMVL-300TA	AMVL-300TA
	Pick up voltage				
	Drop out voltage				
Overload relay (L)	Type	MRA999579200	MRA99954-9201	MRA99960-9201	MRA99954-9201
	Action to the temp. (No current)				
	OFF	165+/-5℃	135+/-5℃	120+/-5℃	135+/-5℃
	ON	69+/-11℃	69+/-11℃	61+/-11℃	69+/-11℃
	Action to the current (AT25℃)	40.0A	29.5A	20.5A	29.5A
	Operation time	6~16sec	6~16sec	6~16sec	6~16sec
	Non-Action to the temp. (80℃)				
	Non-Action				
	Action				
Starting capacitor (L)	Rating	160μF, 250V	160μF, 250V	160μF, 250V	160μF, 250V
Running capacitor (L)	Rating	40μF, 260V	15μF, 400V	15μF, 400V	15μF, 400V
Cap.tube heater	Rating	115VAC 12W	230VAC 12W	230VAC 12W	230VAC 12W
	Resistance (AT25℃)	1102Ω	4.7KΩ	4.7KΩ	4.7KΩ
Temp. control relay	Type	G4F-11123T	G4F-11123T	G4F-11123T	G4F-11123T
	Contact capacity	20A, 250VAC	20A, 250VAC	20A, 250VAC	20A, 250VAC
	Coil	DC12V	DC12V	DC12V	DC12V
H. comp. relay	Type	G4F-11123T	G4F-11123T	G4F-11123T	G4F-11123T
	Contact capacity	20A, 250VAC	20A, 250VAC	20A, 250VAC	20A, 250VAC
	Coil	DC12V	DC12V	DC12V	DC12V
Heater relay	Type	G2R-1A-T	G2R-1A-T	G2R-1A-T	G2R-1A-T
	Contact capacity	10A, 250V	10A, 250V	10A, 250V	10A, 250V
	Coil	DC12V	DC12V	DC12V	DC12V
Temperature sensor	Type	1000Ω	1000Ω	1000Ω	1000Ω
	Rating	THC-663	THC-663	THC-663	THC-663
Cascade sensor	Type	502AT-1	502AT-1	502AT-1	502AT-1
	Rating	5KΩ, 25℃	5KΩ, 25℃	5KΩ, 25℃	5KΩ, 25℃
Filter sensor	Type	502AT-1	502AT-1	502AT-1	502AT-1
	Rating	5KΩ, 25℃	5KΩ, 25℃	5KΩ, 25℃	5KΩ, 25℃
AT sensor	Type	502AT-1	502AT-1	502AT-1	502AT-1
	Rating	5KΩ, 25℃	5KΩ, 25℃	5KΩ, 25℃	5KΩ, 25℃
Power transformer	Type	S41-RN97PV	S41-RN97PV	S41-RN97PV	S41-RN97PV
	Primary	115V	230V	230V	230V
	Secondary	9V	9V	9V	9V
Battery	Type	5HR-AAC	5HR-AAC	5HR-AAC	5HR-AAC
	Rating	6V, 1100MAH	6V, 1100MAH	6V, 1100MAH	6V, 1100MAH
Battery switch	Type	SLE6A2-5	SLE6A2-5	SLE6A2-5	SLE6A2-5
	Rating	4A, 250VAC	4A, 250VAC	4A, 250VAC	4A, 250VAC
Power switch	Type	A8A-202-1			
	Rating	16A, 250V			
Breaker switch	Type		BAM215131	BAM215131	BAM215131
	Rating		15A, 250V	15A, 250V	15A, 250V
Switching power supply	Type	ZWS10-12/J	ZWS10-12/J	ZWS10-12/J	ZWS10-12/J
	Input	100-240VAC	100-240VAC	100-240VAC	100-240VAC
	Output	DC12V, 0.85A	DC12V, 0.85A	DC12V, 0.85A	DC12V, 0.85A
Door switch	Type	SPKNA20700	SPKNA20700	SPKNA20700	SPKNA20700
	Rating	5V, 5MA	5V, 5MA	5V, 5MA	5V, 5MA
Noise filter	Type	ZAC2220-11	ZAC2220-11	ZAC2220-11	ZAC2220-11
	Rating	AC250V, 20A	AC250V, 20A	AC250V, 20A	AC250V, 20A

Specifications of sensor

The following shows the temperature in thermal sensor (502AT-1) and its resistance value.

Temp. (℃)	Resistance Value (kΩ)	Temp. (℃)	Resistance Value (kΩ)	Temp. (℃)	Resistance Value (kΩ)	Temp. (℃)	Resistance Value (kΩ)
−50	154.5	−36	71.80	−22	35.65	0	13.29
−49	145.9	−35	68.15	−21	33.99	5	10.80
−48	137.8	−34	64.71	−20	32.43	10	8.84
−47	130.2	−33	61.48	−19	30.92	15	7.20
−46	123.1	−32	58.43	−18	29.50	20	6.01
−45	116.5	−31	55.55	−17	28.14	25	5.00
−44	110.2	−30	52.84	−16	26.87	30	4.17
−43	104.4	−29	50.23	−15	25.65	35	3.50
−42	98.87	−28	47.77	−14	24.51	40	2.96
−41	93.70	−27	45.45	−13	23.42	45	2.51
−40	88.85	−26	43.26	−12	22.39	50	2.13
−39	84.18	−25	41.19	−11	21.41	55	1.82
−38	79.80	−24	39.24	−10	20.48	60	1.56
−37	75.67	−23	37.39	−5	16.43	65	1.35

The following shows the temperature in thermal sensor (PT1000Ω) and its resistance value.

Temp. (℃)	Resistance Value (Ω)	Temp. (℃)	Resistance Value (Ω)	Temp. (℃)	Resistance Value (Ω)
−140	450.83	−70	729.99	0	1000.0
−130	491.47	−60	769.02	10	1038.0
−120	531.83	−50	807.87	20	1076.0
−110	571.92	−40	846.58	30	1113.8
−100	611.76	−30	885.13	40	1151.4
−90	651.38	−20	923.55	50	1189.0
−80	690.78	−10	961.84	60	1226.4

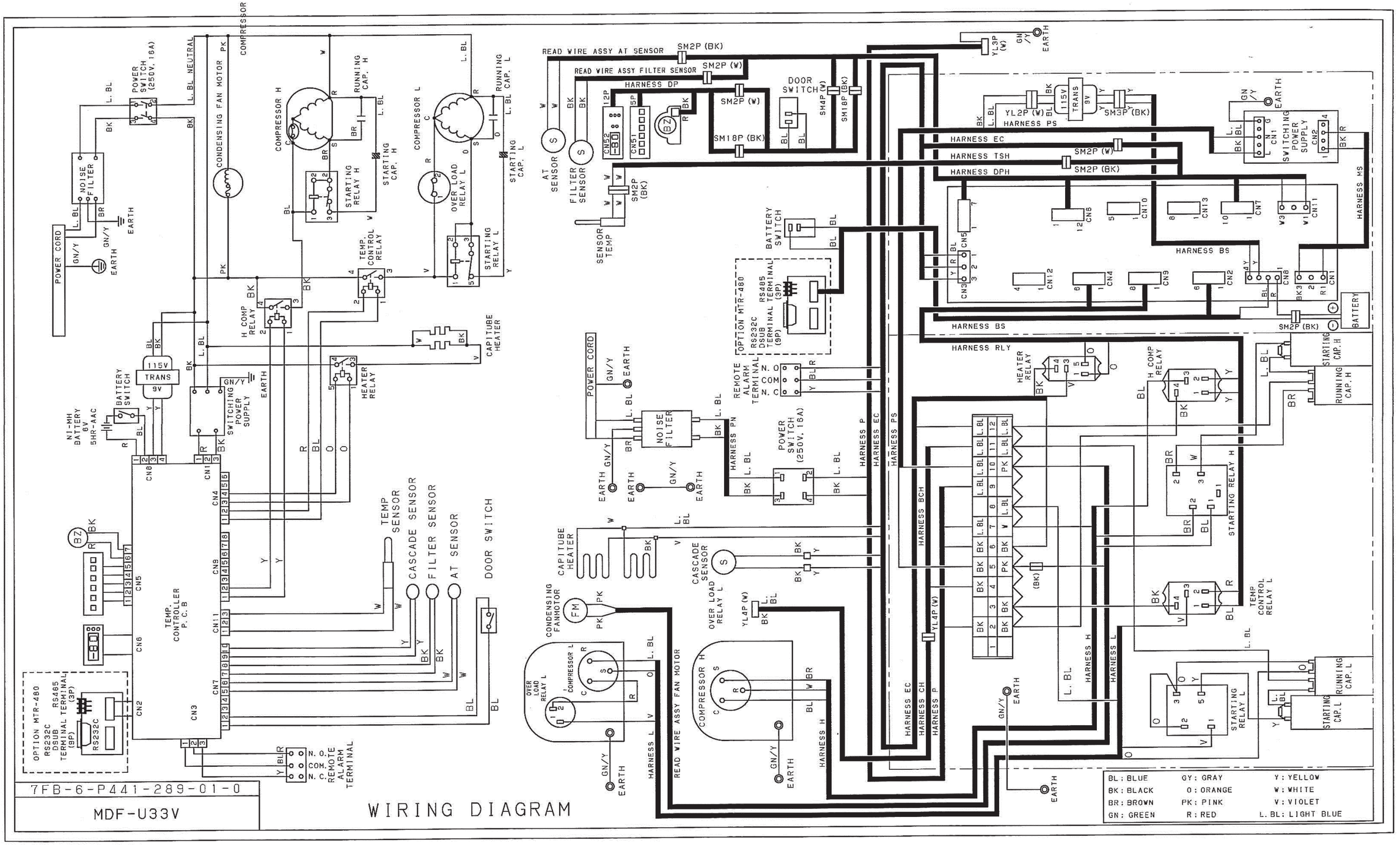
Connections on PCB

The following shows the connections of connectors on the Temp. controller PCB.

Connector	Connects to	Usage
CN1	Switching power supply	To supply the power to PCB. (12VDC)
CN2	Network interface	To connect to MTR-480（option）
CN3	Remote alarm terminal #1: COM. #2: N.O. #3: N.C.	Remote alarm contact outputs. In normal condition, open for #1-#2 and closed for #1-#3.
CN4	#1-#2：Temp. control relay #3-#4：Heater relay	To control internal temperature (12VDC) To supply the power to Cap. tube heater (12VDC)
CN5	#1-#5: Switch PCB #6-#7: Buzzer	To connect to each switch
CN6	Display PCB	To connect to each LED
CN7	#1-#2: Door switch #5-#6: AT sensor #7-#8: Filter sensor #9-#10: Cascade sensor	To control the door switch To detect the ambient temperature To detect the temperature in condenser outlet pipe. To detect the temperature in cascade.
CN8	#1-#2: Battery（#1:6V #2:GND） #3-#4: Transformer	To supply the power during power failure To supply the power to PCB. (9VAC)
CN9	#1-#2: H. Comp. relay	To control compressor H ON/OFF (12VDC)
CN10	Unused	
CN11	#1-#3: Temp. sensor	To detect the internal temperature.

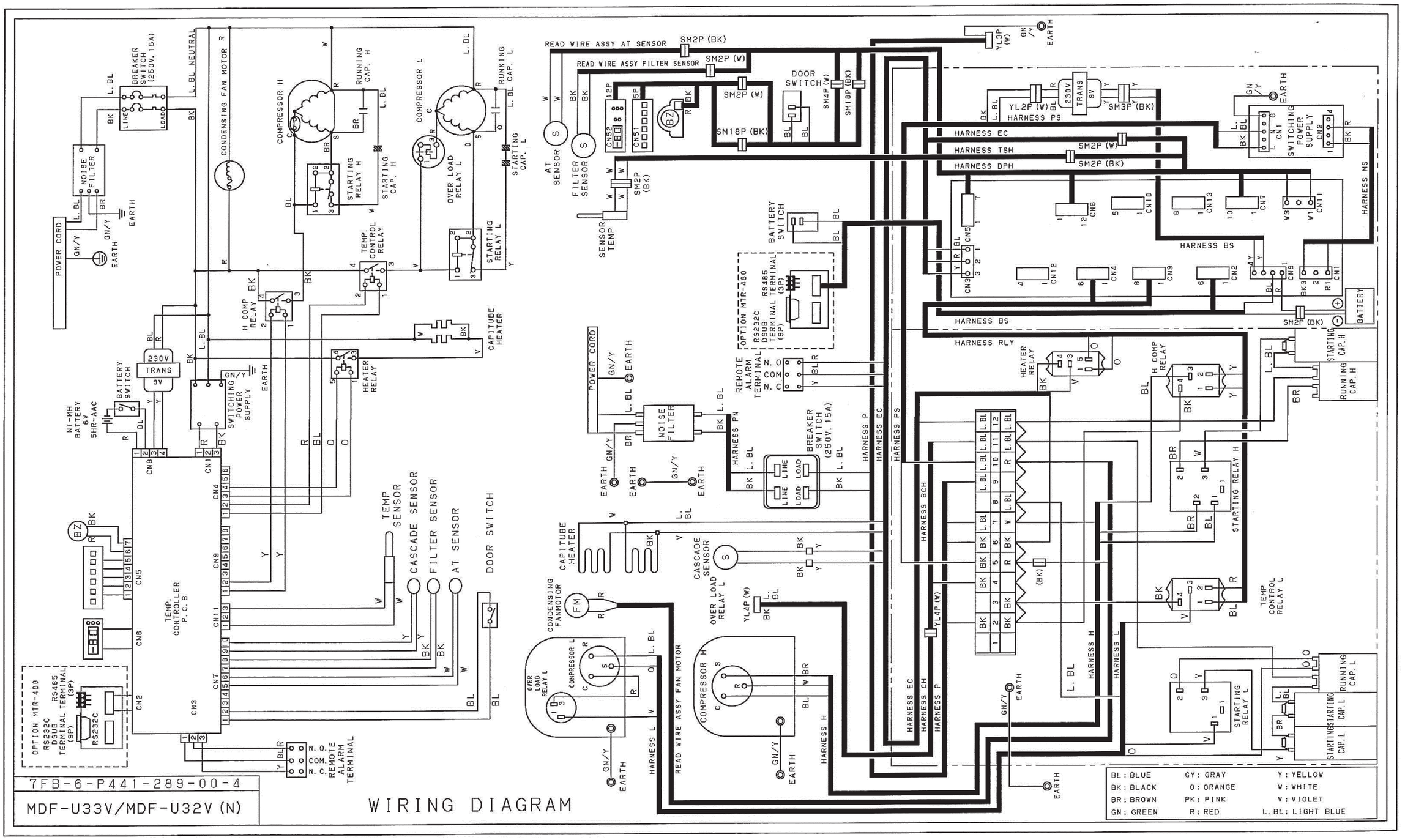
Wiring Diagram

<115V,60Hz>

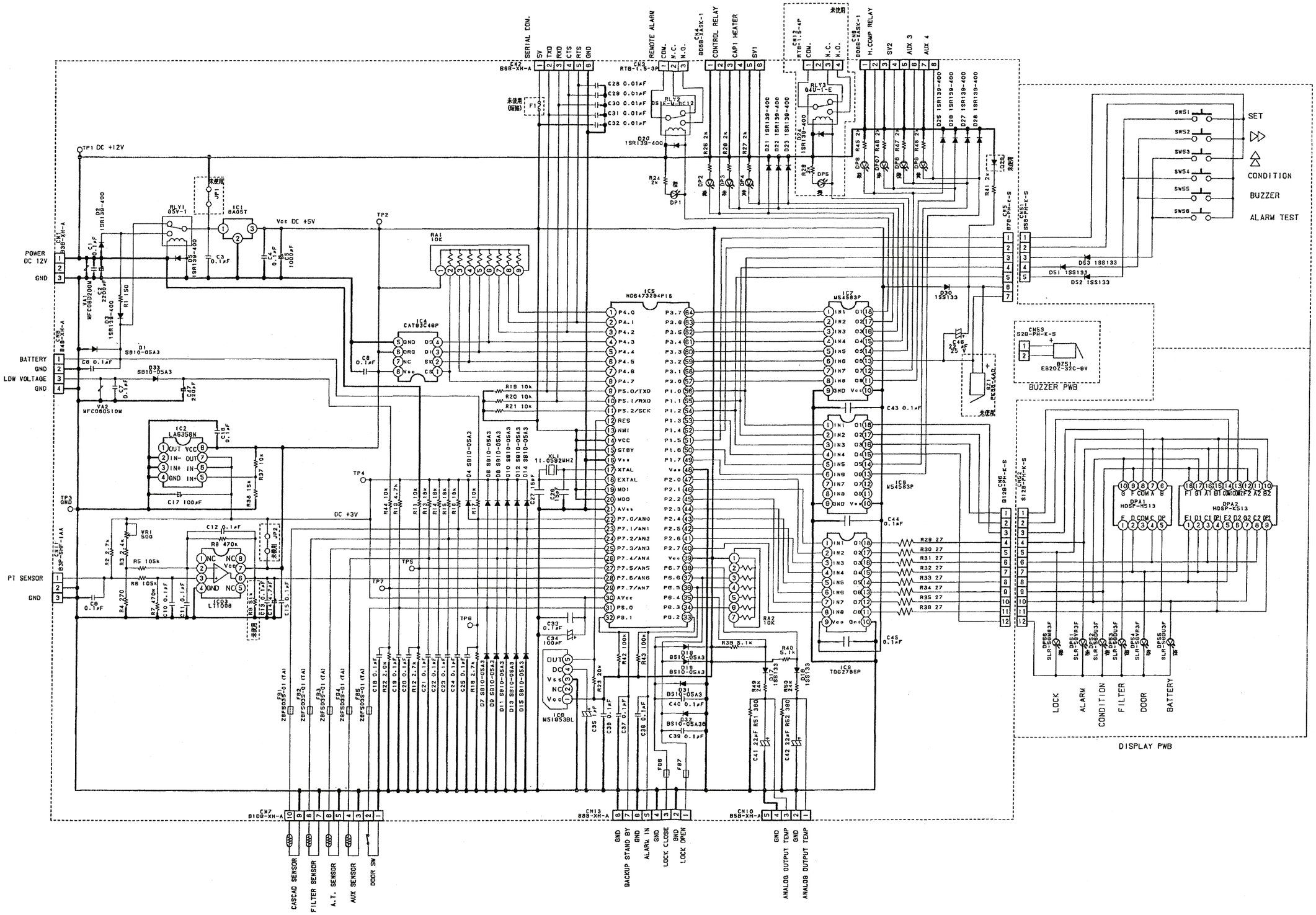


Wiring Diagram

<220～240V,50/60Hz>



Circuit Diagram



Control specification

1. Key and Switch

BUZZER : In alarm condition, buzzer stops sounding with this key pressed.
Remote alarm output and alarm message would not be off.
During the power failure (battery back-up), press the key to show the chamber temperature for 5 seconds.

ALARM TEST : With this key pressed to activate alarm test mode to be forcibly step into alarm condition (ALARM lamp blinks, intermittent buzzer beeps, digital LED goes off and remote alarm activates).
After approx. 90seconds then, unit retrieves normal condition by Auto Return.
With the battery switch turns off, “E09” blinks on the display.

SET : Press this key once to activate set mode (2nd digit in LED blinks), press the key again to store the value to be changed.
With Key Lock setting mode (“L 0” or “L 1” is displayed), press the key to store the value to be changed.

STATUS : During STATUS lamp is lit, press this key to display status code among ‘- - 1’, ‘- - 2’ and ‘- - 3’.

During setting mode, the blinking digit shifts among the 1st digit or the 2nd digit or 3rd digit.
In chamber temperature display, press this key over 5 seconds to shift to Key Lock screen with ‘L_0’ displayed.

During setting mode, count the blinking digit up. In chamber temperature display, press the key over 5 seconds to enter the function mode. (“F00” is displayed)

2. Temperature control

Setting range : -50℃~-90℃
Display range : -180℃~+50℃
Setting procedure : Press SET key and set the required value with key and key. Press SET key to store the set value.
Unacceptable setting range : If you try to set the value which deviates from setting range, the buzzer beeps for 1 second to inform the value unacceptable.

3. Key Lock mode and Function mode

Setting range : 0, 1
Setting procedure: In chamber temperature display, keep pressing key over 5 seconds to enter into Key Lock mode. (“L_0” or “L_1” is displayed. initial: L_0) with “0” or “1” blinks.
Change the value with key and press SET key to store the value in the non-volatile memory.
0: Key Lock inoperative
1: Key Lock operative

4. Function mode

Setting range : 00~32
Display range : 00~39
00, 16 and 33~39 are unavailable.

Setting procedure : In chamber temperature display, keep pressing ▲▲ key over 5 seconds to enter function mode (F00 is displayed). Change the blinking 1st digit to desired function code with ▲▲ key and ▶▶ key. Press SET key to be function code available.
If you input 00 and 16 then press SET key, automatically revert to chamber temperature display.

Unacceptable setting range : If you try to input the value among F33~F39, the buzzer beeps to inform the value unacceptable.

5. Error codes

E01: Temp. sensor is open circuited
E02: Temp. sensor is short circuited
E03: Cascade sensor is open circuited
E04: Cascade sensor is short circuited
E05: Filter sensor is open circuited
E06: Filter sensor is short circuited
E07: AT sensor is open circuited
E08: At sensor is short circuited
E09: Battery switch is off position
E10: Compressor temperature is abnormal

(1) Temp. sensor

Open circuit (E01): When temperature in PT sensor is equal or higher than 50℃, E01 and 50℃ are displayed alternately and the buzzer beeps intermittently and remote alarm contact activates.
Compressor keeps forcibly running.
Press BUZZER key to stop the buzzer beeping.

Short circuit (E02): When temperature in PT sensor is equal or lower than -170℃, E02 and -170 ℃ ~ -180 ℃ are displayed alternately and the buzzer beeps intermittently and remote alarm contact activates.
Compressor keeps forcibly running.
Press BUZZER key to stop the buzzer beeping.

(2) Cascade sensor

Open circuit (E03): When temperature in cascade sensor is equal or higher than 60℃, E03 and chamber temperature are displayed alternately, the buzzer beeps intermittently and remote alarm contact activates.
High side compressor is forcibly turned on and low side compressor is turned off.
Press BUZZER key to stop the buzzer beeping.

Short circuit (E04): When temperature in cascade sensor is equal or lower than -65℃, E04 and chamber temperature are displayed alternately, the buzzer beeps intermittently and remote alarm contact activates.
High side compressor is forcibly turned on and low side compressor is not controlled in any cascade temperature.
Press BUZZER key to stop the buzzer beeping.

(3) Filter sensor

Open circuit (E05): When the temperature in filter sensor is equal or higher than 130℃, E05 and chamber temperature are displayed alternately, the buzzer beeps intermittently and remote alarm contact activates.
High side compressor is forcibly turned off.
Press BUZZER key to stop the buzzer beeping.

Short circuit (E06): When the temperature in filter sensor is equal or lower than -60℃, E06 and chamber temperature are displayed alternately, the buzzer beeps intermittently and remote alarm contact activates.
Press BUZZER key to stop the buzzer beeping.

(4) AT sensor

Open circuit (E07): When the temperature in AT sensor is equal or higher than 60℃, E07 and chamber temperature are displayed alternately, the buzzer beeps intermittently and remote alarm contact activates.
Unit should have warming-up operation when low side compressor is turned on.
Press BUZZER key to stop the buzzer beeping.

Short circuit(E08): When the temperature in AT sensor is equal or lower than -60℃, E08 and chamber temperature are displayed alternately, the buzzer beeps intermittently and remote alarm contact activates.
Unit should have warming-up operation when low side compressor is turned on.
Press BUZZER key to stop the buzzer beeping.

(5) Battery SW is off position (E09): If you press ALARM TEST key when battery switch is off position or battery is unconnected, E09 is displayed.

(6)Compressor abnormal temperature (E10): When the temperature in filter sensor is equal or higher than 60℃, E10 and chamber temperature are displayed alternately and high side compressor is forcibly turned off to inform compressor temperature is abnormal or fan motor locked.
Press BUZZER key to stop the buzzer beeping.
When the temperature in filter sensor – AT is equal or lower than 10℃, compressor is turned on.

(7) Error code priority

No.1: Cascade sensor (E03, E04) … High side compressor is forcibly turned on
No.2: Filter sensor (E05, E06) … Compressor protection is uncontrollable
No.3: Abnormal compressor temp.(E10) … Compressor temporary turns off
No.4: Temp. sensor (E01, E02) … Compressor keeps forcibly running
No.5: AT sensor (E07, E08) … Warming-up operation in any AT

6. Alarms

High temp. alarm : When chamber temperature is equal or higher than set temperature + high temp. alarm set temperature +1.0, ALARM lamp and LED display blinks, intermittent buzzer beeps with approx. 10 minutes of delay and remote alarm activates.
When chamber temperature is equal or lower than set temperature, ALARM lamp and LED display go off, buzzer stops beeping and remote alarm turns off.
If you press BUZZER key, the buzzer stops beeping instead remote alarm does not turn off.

Low temp. alarm : When chamber temperature is equal or lower than set temperature - low temp. alarm set temperature -1.0, ALARM lamp and LED display blinks, intermittent buzzer beeps with approx. 10 minutes of delay and remote alarm activates.
When chamber temperature is equal or higher than set temperature – low temp. alarm set temperature, ALARM lamp and LED display go off, buzzer stops beeping and remote alarm output turns off.
If you press BUZZER key, the buzzer stops beeping instead remote alarm does not turn off.

Door alarm : Leave the outer door open and DP54 (red lamp) is lit. Buzzer beeps intermittently after 1~15 min. (Door alarm setting time) has elapsed. Initial setting time is 2 min. Buzzer does not activate simultaneously with remote alarm. Once you press BUZZER key, buzzer does not beep again

Power failure alarm : With the battery switch is on position and power switch is turned off or the power is interrupted for 3 seconds, ALARM lamp blinks and intermittent buzzer beeps and remote alarm activates.
When the power retrieves within 3 seconds after the power failed, micro computer is initialized and remote alarm turns off.
Press BUZZER key to stop buzzer beeping instead remote alarm does not turn off.
Remote alarm activates until chamber temperature is stabilized.
You can check chamber temperature for 5 seconds if you press BUZZER key during power failure.

7. Running rate

Calculation
Running rate = (ON time / (ON time + OFF time)) X 100%

Measuring condition
After 2hrs has elapsed since chamber temperature was equal or less than set temperature
ON time (min) = The period which P3.1 in IC5 first switches from Low to HIGH
OFF time (min) = The period which P3.1 in IC5 switches from HIGH to LOW

Measuring period
Measuring should be started from 2hrs has passed since chamber temperature is equal or less than set temperature and completed after 8hrs has passed then.

Condition
(a) When ON time and OFF time is higher than 0, you can calculate running rate. (range 0~100%)
(b) When ON time and OFF time is 0, you cannot calculate running rate.
(c) When ON time is higher than 0 while OFF time is 0, you cannot calculate running rate.
(d) When ON time is 0 while OFF time is higher than 0, you cannot calculate running rate.

Reset of calculation
When chamber temperature is higher than set temperature +4C, you should reset calculation and restart it after chamber temperature would be stabilized.

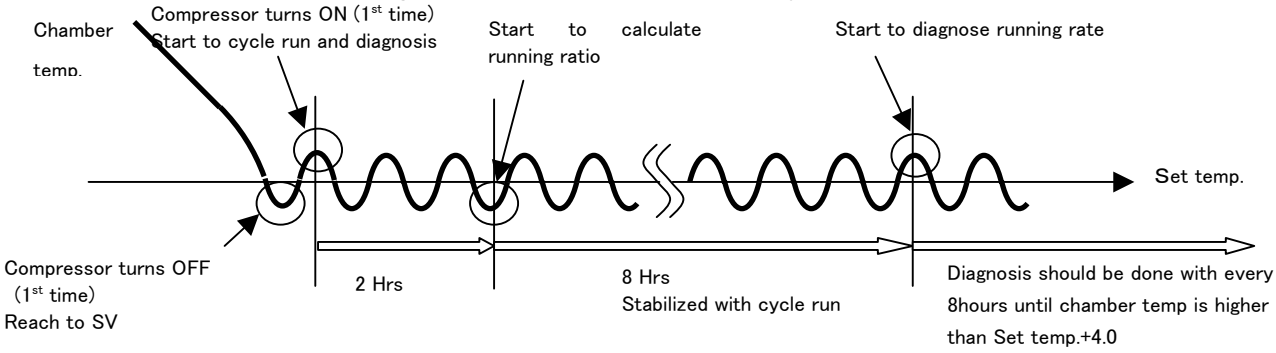
Diagnosed running rate
=(-(Set temp.)X0.9)+((ATX0.9-4.5℃))-((Set temp.+85℃) / 10))

8. Monitor of status

DP52 (orange lamp) is lit in the following status;
Status 1; When AT is equal or higher than 35.0C or AT is equal or lower than 0C, press STATUS key to display '- - 1'.
Status 2; When the value in F23 is equal or less than 85% running rate, press STATUS key to display '- - 2',
Status 3; When running rate is over than 95%, press STATUS key to display ' - - 3'.

Diagnosis
(Ex.) Set temperature; -80℃ AT; 30℃
Diagnosed running rate; 95% (Fixed)
Running rate; 75% (8Hrs running and 6Hrs compressor ON time)
Running rate (75%) - Diagnosed running rate (95%) < 0
… 'Normal' (DP52 is gone off)
Running rate – Diagnosed running rate ≧0
… Overloaded run (DP52 is lit)
Impossible to calculate running rate = 222
… Impossible to diagnose (DP52 is gone off)

Diagnosis should be done in every 8 hours.


Chamber temp.
Compressor turns ON (1st time)
Start to cycle run and diagnosis
Start to calculate running ratio
Start to diagnose running rate
Set temp.
Compressor turns OFF (1st time)
Reach to SV
2 Hrs
8 Hrs
Stabilized with cycle run
Diagnosis should be done with every 8hours until chamber temp is higher than Set temp.+4.0

9. Other functions

Auto Return : If there is not any key operation for 90 seconds in each setting mode, Key Lock mode and Function mode, automatically reverts to chamber temperature mode.
Note) Auto Return is not worked in F09 and F10.

Alarm resume time : This is the function to prevent someone pressing BUZZER key to stop buzzer beeping when the unit is into alarming condition.
Press BUZZER key to stop buzzer beeping. Buzzer beeps again after a certain alarm resume time elapses.
Alarm resume time is settable in F25. (See Function mode for details)

Sensor temperature : F12: Temperature of temp. sensor is displayed
(Ex. -80.2℃ → displayed as '80.2')
F13: Temperature of cascade sensor is displayed.
(Ex. -34℃ → displayed as '-34℃')
F14: Temperature of filter sensor is displayed.
(Ex. 67℃ → displayed as '067')
F15: Temperature of AT sensor is displayed.
(Ex. 30℃ → displayed as '030')

Battery accumulation time :
F03: Battery accumulation time is displayed.
(Ex. 2years and 6months accumulated → displayed as '02.5')
The display shows '02.8' to inform the battery exhaustion.
Replace with new battery.
<Reset of accumulation time>
Step into F06. Input '**409**' and press SET key to turn the display to '00.0' with BATTERY lamp (DP55) goes off.

Condensing fan motor accumulation time :
F32: Condensing fan motor accumulation time is displayed.
(Ex. 5years and 6months consumed → displayed as '05.5')
<Reset of accumulation time>
Step into F06. Input '**419**' and press SET key to turn the display to '00.0' with DP55 lamp goes off.
Note) Notice of condensing fan motor accumulation time is prior to notice of battery accumulation time.

Capillary heater operation :
F18: Input '000' to stop compressor operation and to conduct electricity in capillary heater. Input '000' again to stop capillary heater operation when capillary heater is conducted electricity.
Input '001' to have capillary heater inoperative, while the compressor stops operation in every 18 hours.

ROM version :
F30: ROM version is displayed (Ex. Ver. 1.00 → displayed as "1.00")

10. Function mode

F00	Automatically revert to chamber temperature display
F01	Setting of High temp. alarm set temperature
F02	Setting of Low temp. alarm set temperature
F03	Display of battery accumulation time
F04	Setting of Door alarm delay time
F05	Setting of High side compressor delay time
F06	Service code input (code: 384)
F07 *	Temperature Zero Adjustment
F08 *	Cascade sensor Zero Adjustment
F09	Factory test mode …… Unavailable
F10	Factory test mode …… Unavailable
F11	Factory test mode …… Unavailable
F12 *	Display of temperature in temp. sensor
F13 *	Display of temperature in cascade sensor
F14 *	Display of temperature in compressor sensor
F15 *	Display of temperature in AT sensor
F16*	Automatically revert to chamber temperature display
F17 *	Model code setting (Initialization of non-volatile ROM and memory)
F18 *	Capillary heater is forcibly turned on/off
F19	Factory test mode …… Unavailable
F20	Factory test mode ... ... Unavailable
F21	Communication ID set
F22	Communication mode set
F23 *	Display of power supply voltage
F24	Remote alarm terminal output
F25	Alarm resume time set
F26 *	Display of actual operation rate
F27 *	Display of diagnosis value for running rate
F28 *	Display of delay time of permission for measuring running rate (2 hrs timer)
F29 *	Display of delay time of permission for measuring running rate (8 hrs timer)
F30 *	ROM version is displayed
F31 *	Filter alarm
F32 *	Display of condensing fan motor accumulating time
F33~F39	Unused

Setting procedure: In chamber temperature display, keep pressing ▲▲ key over 5seconds to display "F00".
Input the desired function code with ▲▲ key and ▶▶ key.
Press SET key to be function mode available.
* … You should input service code in F06 beforehand.
To cancel service code, input "000" in F06 or turn the power off.

F00: <Purpose> Simply passing through if entered by mistake.
<Operation> Press SET key in "F00" displayed to revert to chamber temperature display.

F01: <Purpose> To set high temp. alarm set temperature
<Operation> Input F01 and press SET key to display "010" (initial value).
Set the value in the range "005"~"020" with ▲▲ key and ▶▶ key. Press SET key to store the value and revert to chamber temperature display.

F02: <Purpose> To set low temp. alarm set temperature
<Operation> Input F02 and press SET key to display "-10" (initial value).
Set the value in the range "-05"~"-20" with ▲▲ key and ▶▶ key. Press SET key to store the value and revert to chamber temperature display.

F03: <Purpose> Battery accumulation time is displayed
<Operation> Input F03 and press SET key to display alternately F03 with "00.0" (in case battery used for a month or less). Press SET key to revert to chamber temperature display.
<Reset> Input '409' and press SET key to initialize battery accumulation time. ('00.0' is displayed)

F04: <Purpose> Door alarm delay time is set
<Operation> Press SET key in "F04" displayed to display '002' (initial setting).
Change your desired value among '001'~'015' with ▲▲ key and ▶▶ key and press SET key to store the value and revert to chamber temperature display.

F05: <Purpose> To have High side compressor operation being delayed when the power is supplied or the power retrieves from the power failure. (Unit: Minute)
<Operation> Input "F05" and press SET key to display "002" (initial).
Change the value in the range "002"~"015" with ▲▲ key and ▶▶ key. Press SET key to store the value and revert to chamber temperature display.

F06: <Purpose> Dividing F-code for customer used from service
<Operation> Input F06 and press SET key to display "000" (initial value).
Set to "384" with ▲▲ key and ▶▶ key. Press SET key to store the value and revert to chamber temperature display.
<Reset of battery accumulation time>
Input service code, '384' then '409' to reset battery accumulation time. Unit automatically reverts to chamber temperature display.
<Reset of fan motor accumulation time>
Input service code, '384' then '419' to reset fan motor accmulation time. Unit automatically reverts to chamber temperature display.

<Cancel> Input F06 and press SET key to display “384”.
Change to “000” with ▲▲ key and ▶▶ key. Press SET key to store the value and revert to chamber temperature display.
Service code ‘384’ is not effective after the reset of battery or fan motor accumulation time.
Power the unit on and off to initialize (‘000’) service code which is not memorized in non-volatile memory.
Note) ‘384’ is storied in non-volatile memory during battery back-up. (battery SW is ON)

F07: <Purpose> To match temperature of temp. sensor with temperature of center at the chamber.
<Operation> Input service code in F06 prior to use this mode.
Input F07 and press SET key to display “00.0” (initial value).
Change to the desired value in the range “-4.9”~”04.9” with ▲▲ key and ▶▶ key.
Press SET key to store the value and revert to chamber temperature display.

F08: <Purpose> To calibrate temperature of cascade sensor
<Operation> Input service code in F06 prior to use this mode.
Input F08 and press SET key to display “00.0” (initial value).
Change to the desire value in the range “-9.9”~”09.9” with ▲▲ key and ▶▶ key.
Press SET key to store the value and revert to chamber temperature display.

F12: <Purpose> To display the temperature of temp. sensor
<Operation> Input service code in F06 prior to use this mode.
Input F12 and press SET key to display alternately F12 and “XX.X” (present internal temperature). Press SET key to revert to chamber temperature display. 3 digits indication. Minus “-“ is not indicated.
Ex) “-79.5℃” → indicated as “79.5”

F13: <Purpose> To display the temperature of cascade sensor
<Operation> Input service code in F06 prior to use this mode.
Input F13 and press SET key to display alternately F13 and “XX.X” (present temperature of cascade sensor). Press SET key to revert to chamber temperature display.

F14: <Purpose> To display the temperature of filter sensor
<Operation> Input service code in F06 prior to use this mode.
Input F14 and press SET key to display alternately F14 and “XX.X” (present temperature of filter sensor). Press SET key to revert to chamber temperature display.

F15: <Purpose> To display the temperature of AT sensor
<Operation> Input service code in F06 prior to use this mode.
Input F15 and press SET key to display alternately F15 and “XX.X” (present temperature of AT sensor). Press SET key to revert to chamber temperature display.

F16: <Purpose> Simply passing through if entered by mistake.
<Operation> Press SET key in “F16” displayed to revert to chamber temperature display.

F17: <Purpose> Non-volatile memory initialization, model code change

<Operation> Service code should be input in F06 prior to use this mode.

Input F17 and press SET key to display “001”. Change the value with ▲▲ key and ▶▶ key. Press SET key to store and revert to chamber temperature display.

Model code is identified by its power source.

Model code ‘002’: 115V

‘003’: 220-240V

<Initial values in Non-volatile memory>

PT sensor Zero Adjustment value	: 0 C
Cascade sensor Zero Adjustment value	: 0 C
Capillary heater turning on time	: 8 min.
Auto Recovery time	: 30 min.
Chamber temperature	: -80 C
Door alarm delay time	: 2 min.
High temp. alarm temperature	: +10 C
Low temp. alarm temperature	: - 10 C
Compressor delay time	: 3 min.
Communication ID	: 000
Communication mode	: 000
Key Lock	: OFF
Remote alarm and buzzer operation	: OFF
Filter alarm buzzer	: OFF
Diagnosed value of Status 3	: ON
Data to check non-volatile memory	:

F18: <Purpose> To turn capillary heater on/off

<Operation> Service code should be input in F06 prior to use this mode.

Input F18 and Press SET key to display “000” (initial).

Change to desire value “000” or “001” with ▲▲ key and ▶▶ key.

Press SET key to store the value and revert to chamber temperature display.

000: Capillary heater is forcibly turned on/off

001: Capillary heater is inoperative

F23: <Purpose> To display the power supply voltage (Unit: %)

<Operation> Service code should be input in F06 prior to use this mode.

Input F23 and press SET key to display F23 and ‘xxx’ (present power supply voltage) alternately. Press SET key to revert to chamber temperature display.

F24: <Purpose> To set remote alarm and buzzer operation

<Operation> Input F24 and Press SET key to display “000” (initial).

Change to the desired value with ▲▲ key and ▶▶ key.

Press SET key to store the value and revert to chamber temperature display.

000: Remote alarm operation is not synchronous with buzzer

001: Remote alarm operation is synchronous with buzzer

F25: <Purpose> Alarm auto recovery time setting

<Operation> Input F25 and press SET key to display “030” (initial).

Change to the desired value with ▲▲ key and ▶▶ key.

Press SET key to store the value and revert to chamber temperature display.

000: Auto recovery OFF
010: Recovers after 10min. elapse
020: Recovers after 20min. elapse
030: Recovers after 30min. elapse (initial)
040: Recovers after 40min. elapse
050: Recovers after 50min. elapse
060: Recovers after 60min. elapse

F26: <Purpose> Running rate is displayed (unit: %)
<Operation> Service code should be input in F06 prior to use this mode.
Input F26 and press SET key to display alternately F26 with “XXX” (present running rate).
Press SET key to revert to chamber temperature display.

F27: <Purpose> Diagnosed value of overloaded running rate is displayed
<Operation> Service code should be input in F06 prior to use this mode.
Input F27 and press SET key to display alternately F27 with “095” (initial value, present diagnosed value of overloaded running rate).
However ‘000’ is displayed if it does not accumulate 480 min by 8H timer.
Press SET key to revert to chamber temperature display.

F28: <Purpose> To display delay time of permission of measuring running rate (2hrs timer; 000~120 min)
<Operation> Service code should be input in F06 prior to use this mode.
Input F28 and press SET key to display F28 and ‘xxx’ (present count value) alternately. Press SET key to revert to chamber temperature.

F29: <Purpose> To display delay time of permission of measuring running rate (8hrs timer; 000~480 min)
<Operation> Service code should be input in F06 prior to use this mode.
Input F29 and press SET key to display F29 and ‘xxx’ (present count value) alternately. Press SET key to revert to chamber temperature.

F30: <Purpose> ROM version is displayed
<Operation> Service code should be input in F06 prior to use this mode.
Input F30 and press SET key to display alternately F30 with “1.00” (Version 1.00).
Press SET key to revert to chamber temperature display.

F31: <Purpose> Buzzer setting during filter alarm
<Operation> Input F31 and press SET key to display “001” (initial).
Change to the desired value with ⏫ key and ⏩ key.
Press SET key to revert to chamber temperature display.
000: Buzzer off
001: Buzzer on

F32: <Purpose> To display condensing fan motor accumulation time
<Operation> Input F32 and press SET key to display F32 and ’00.0’ (e.g. Accumulation period should be within 36days) alternately. Press SET key to revert to chamber temperature display.
<Reset> Input ‘419’ in F06 and press SET key to initialize fan motor accumulation time. (’00.0’ is displayed)

11. Low side compressor warming-up operation (for 115V/60Hz model only)

Condition:

When the unit starts running with ambient air is lower than 25℃, occasionally it causes the Low side compressor being inoperative. The Low side compressor would have warming-up operation by added the voltage with specified frequency to start it without fail.

Timing of the voltage added:

20 seconds with 3 minutes intervals
(*Note) Frequency to add the voltage is depend on the ambient temperature.

<Frequency to add the voltage with 3 min. interval>

Ambient temp. display	Frequency
Equal or lower than 5℃	14
5~14℃	9
15 ~ 24℃	6
Equal or higher than 25℃	None
Sensor open or short circuit	9

Re-warming up:

When the Low side compressor seizes for 120 min. or longer because of a power failure or set temperature change, the Low side compressor would have re-warming up operation.

(*Note) This function is not available when the power switch is off or the power retrieves within 3 seconds before the power failure alarm activates.

Abeyance of warming-up:

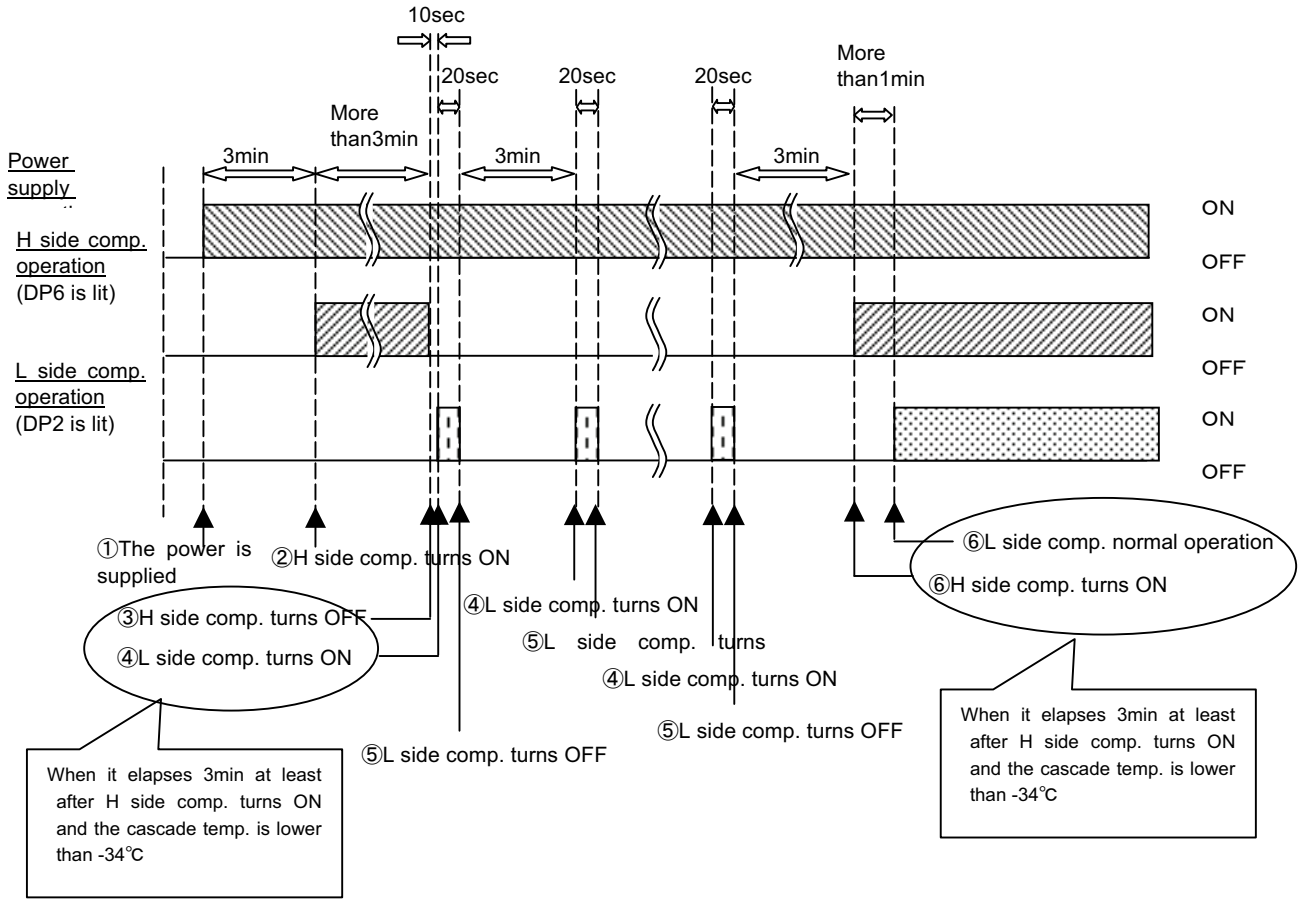
When the chamber temperature is equal or lower than set temperature + 10℃, the unit diagnoses as a temporary power failure and the Low side compressor ceases warming-up operation. The resistance value in PT sensor can be used as the chamber temperature.

The unit shifts operation to cycle run and the Low side compressor starts operation after 1 min. elapse with the cascade temperature is equal or lower than -34℃.

Sequence of Warming-up:

(1) The power is supplied
(2) High side compressor turns on after the delay time elapses.
(3) High side compressor operates for 3 min. at least and the High side compressor turns off when the cascade temperature is reached to -34℃.
(4) Low side compressor turns on with 10 sec. of delay after High side compressor turned off.
(5) Low side compressor operates for 20 sec. and turns off.
(6) Low side compressor restarts with 3 min. intervals and repeats warming-up operations as specified frequency. High side compressor turns on again.
(7) Low side compressor follows normal operation.

<Timing chart of Low side compressor warming-up>

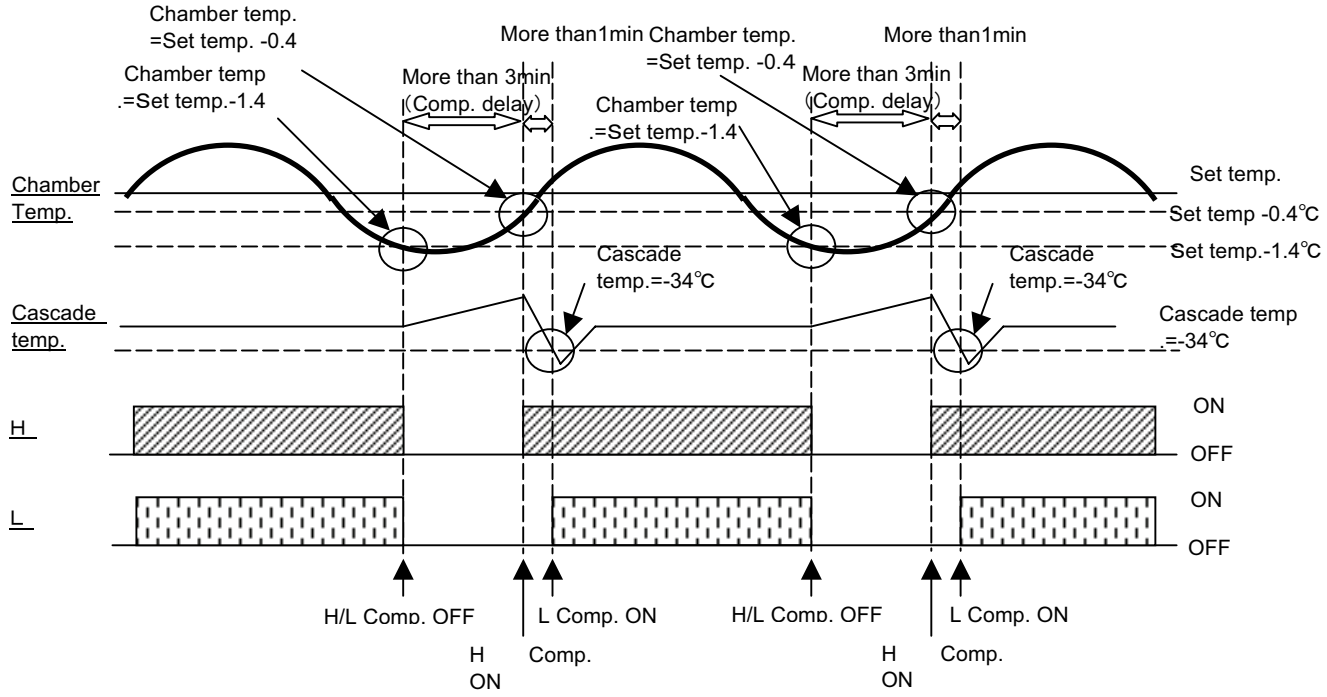

10sec
20sec
20sec
20sec
More than1min
More than3min
3min
3min
3min
Power supply
H side comp. operation (DP6 is lit)
L side comp. operation (DP2 is lit)
ON
OFF
ON
OFF
ON
OFF
①The power is supplied
②H side comp. turns ON
③H side comp. turns OFF
④L side comp. turns ON
⑤L side comp. turns OFF
④L side comp. turns ON
⑤L side comp. turns
④L side comp. turns ON
⑤L side comp. turns OFF
⑥L side comp. normal operation
⑥H side comp. turns ON
When it elapses 3min at least after H side comp. turns ON and the cascade temp. is lower than -34℃
When it elapses 3min at least after H side comp. turns ON and the cascade temp. is lower than -34℃

12. Differential (The point of compressor ON and OFF)

High side comp. ON:	When chamber temperature is set temperature -0.4℃
High/Low side comp. OFF:	When chamber temperature is set temperature -1.6℃
Low side comp. ON:	When High side comp. turns on and cascade temp. is -34℃
Interval of High/Low comp. ON:	1 min.

*Note) The Low side compressor turns on only when 1 minute elapse since the High side compressor turned on and the cascade temperature is reached to -34℃.

<Compressor control during cycle operation>



*Note) When the failure is occurred in the cascade sensor, the Low side compressor should be solely controlled and the High side compressor is forcibly turned on.

High side compressor protection:
The High side compressor is turned off to prevent the compressor being warmed up that is caused by the fan motor locked.

Filter sensor temperature:
The High side compressor is turned off when the filter sensor temperature is equal or higher than 60℃. The High side compressor is turned on again when the filter sensor temperature is equal or lower than ambient temperature +10℃.

13. Delay time

Compressor delay time (Initial: 3 minutes)
When the compressor seizes during cycle operation, Low/High side compressors restarts with the delay time. You can set the desired delay time in F05.

Temperature alarm delay time (Initial: 10 minutes)
When high or low temperature alarm is triggered, buzzer and remote alarm activate with the delay time. You can set them in F01 and F02.
* Note) ALARM lamp and the indication activate without delay.

Door alarm delay time (Initial: 2 minutes)
When the outer door is open, the buzzer activates with the delay time.
You can set the desired delay time in F04.

Power failure alarm delay time (3 seconds fixed)
When the power is failed, the power failure alarm activates with 3 seconds of delay.
You cannot change the delay time.

14. Prevention for oil logged in the capillary

Purpose:

Capillary heater is conducted electricity by regularly turning both the High and Low side compressor off to prevent oil logged in the capillary.

Operation:

Both the High and Low side compressor are turned off, while the capillary heater relay (CN4: 3-4) is turned on. DP3 (red lamp) is lit.

Frequency:

8 minutes in every 18 hours (Minutes are changeable in F19)

Timing of operation:

(1) 9 seconds after both the High and Low side compressor are turned off during cycle operation.

(2) Both the High and Low side compressor are forcibly turned off if they keep running for 60 minutes or more after they were ordered to turn off.

Operation of capillary heater:

Capillary heater is forcibly ON/OFF controlled in F18.

15. Sensor offset

Sensor offset value:

(1) Temperature sensor: +1.3℃ (Changeable in F07)

(2) Cascade sensor: +/-0.0℃ (Changeable in F08)

(3) Filter sensor: +/-0.0℃

(4) AT sensor: +/-0.0℃

16. Remote alarm terminal

Operation:

Once the alarm is triggered, the remote alarm contact (RLY2) switches the position.

	CN3	
	1 – 2 (N.O.)	1 – 3 (N.C.)
Normal	Open	Close
In alarm	Close	Open

17. Power reset

Setting values after the power is reset:

Alarms: OFF
Compressors: OFF
Remote alarm: OFF
Alarm resume time: 30 minutes
Door alarm delay time: 2 minutes
Timers: Reset
2H timer, 8H timer: 0 (Reset)
Warming-up operation: ON
Counting for Low side compressor OFF period: Reset
Setting data: Referred to non-volatile memory

Momentary power failure:

Status of the unit should be diagnosed by comparing the chamber temperature with the set temperature. When the chamber temperature is equal or lower than the set temperature +10℃, it diagnoses as 'Momentary power failure'. The Low side compressor warming-up operation should be cancelled.

Setting values after power retrieves from power failure:

Alarms: OFF
Compressors: OFF
Remote alarm: ON
Door alarm delay time: 2 minutes
Setting data: Refer to non-volatile memory
Timers: Reset
2H timer, 8H timer: 0 (Reset)
Warming-up operation: OFF
Counting of period Low side compressor turns off: Reset

18. Other specifications

Lamp operation:

<Control PCB>

DP1: Orange lamp
Goes off: High/low temp. alarm (15min. delay), sensor error, power failure
Lit : Not in alarm condition

DP2: Green lamp
Goes off: Low side compressor turns off. (normal condition)
Lit : Low side compressor turns on.

DP3: Red lamp
Goes off: Capillary heater turns off. (normal condition)
Lit : Capillary heater turns on.

DP4: Yellow lamp (Unused)

DP6: Green lamp
Goes off: High side compressor turns off. (normal condition)
Lit : High side compressor turns on.

<Display PCB>

DP51: Red lamp
Goes off: Not in alarm condition (normal condition)
Blinks : High/low temp. alarm (without delay), or sensor failure, or power failure

DP52: Green lamp
Goes off: Inoperative
Lit : In STATUS

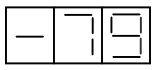
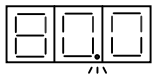
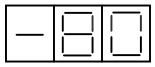
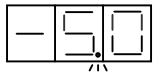
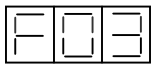
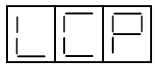
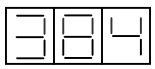
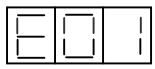
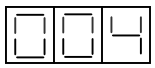
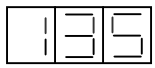
DP53: Orange lamp
Goes off: Not in filter alarm (normal condition)
Lit : In filter alarm

DP54: Red lamp
Goes off: Inoperative
Lit : Door ajar

DP55: Orange lamp
Lit : Battery accumulation time is reached to 3 years
Blinks : Fan motor accumulation time is reached to 6 years

DP56: Unused

Examples of display:

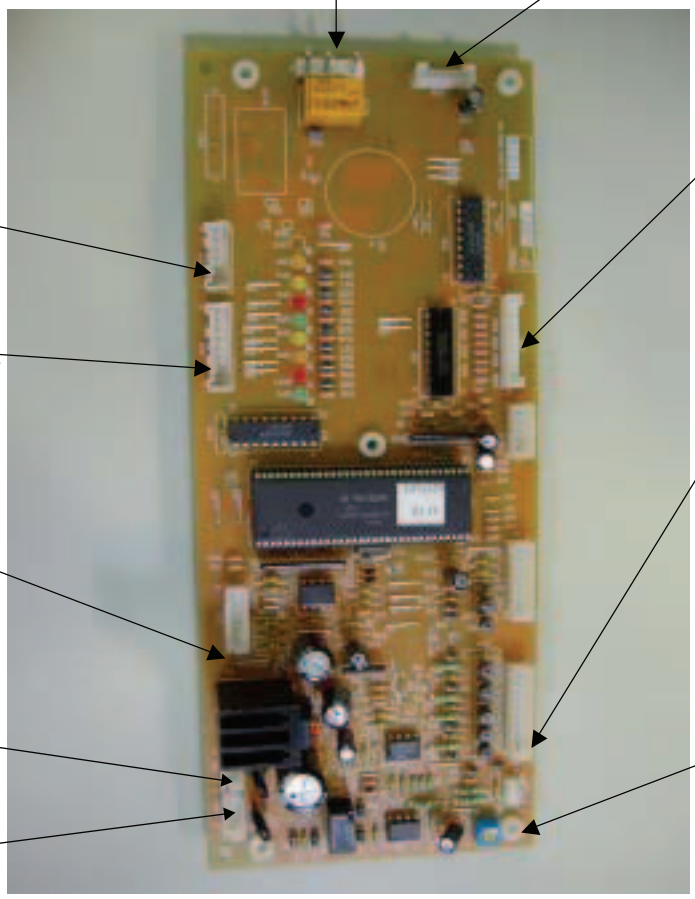
Chamber temp.	-79.5℃		Decimal point of chamber temp.	-80.0	
Set temp.	-80.0℃		Sensor offset	-5.0	
Function	F03		Operation monitoring	LCP	
Service code	384		Error	E01	
Set value	004		Accumulation time	8H timer 135	
Key Lock	L_0				

Buzzer tone:

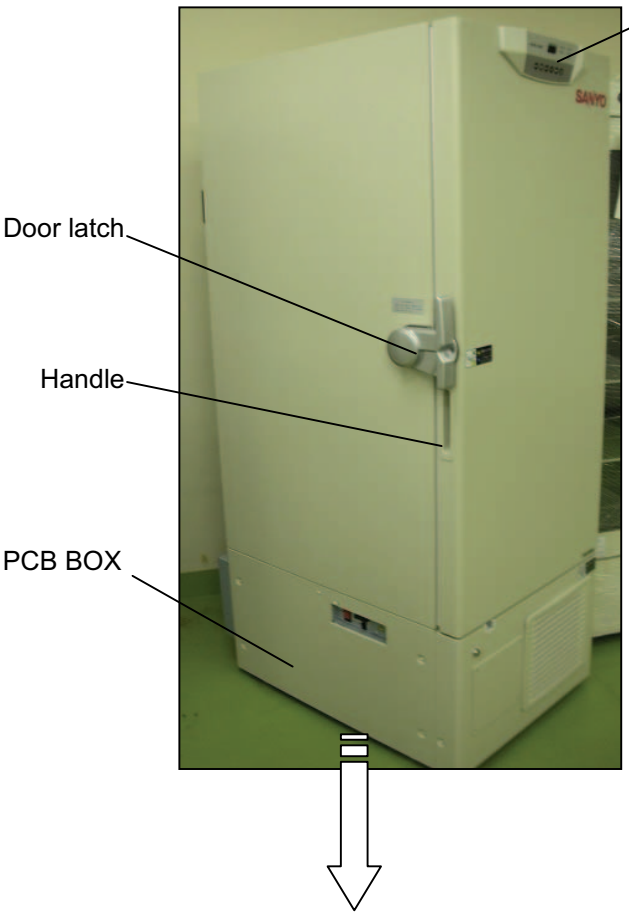
Alarms (except door alarm)	Intermittent tone
Key operation	Click tone
Set value memory	Click tone
Out of settable range	1 second continuous tone
Door alarm	Intermittent tone with shorter intervals than any other alarms

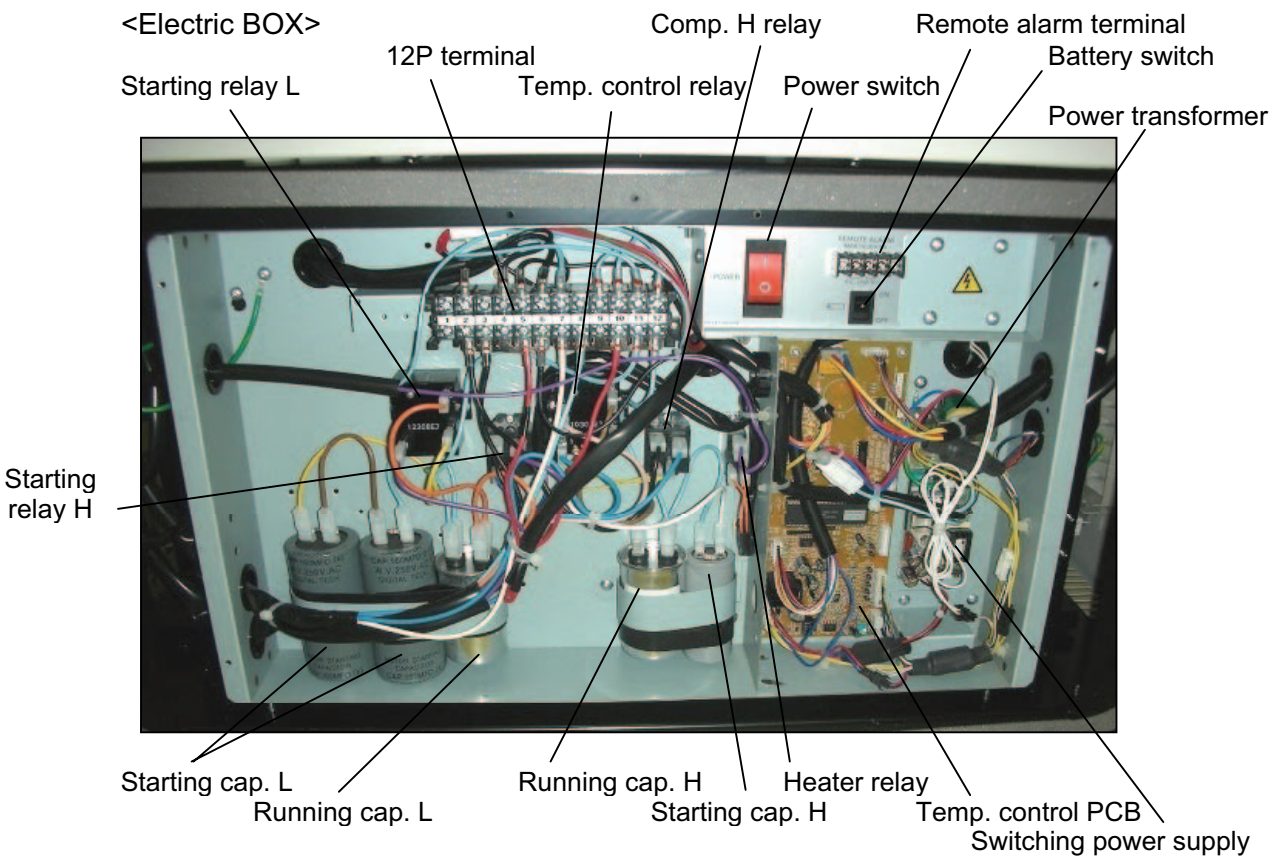
Parts layout

<Temp.controller P.C.B.>

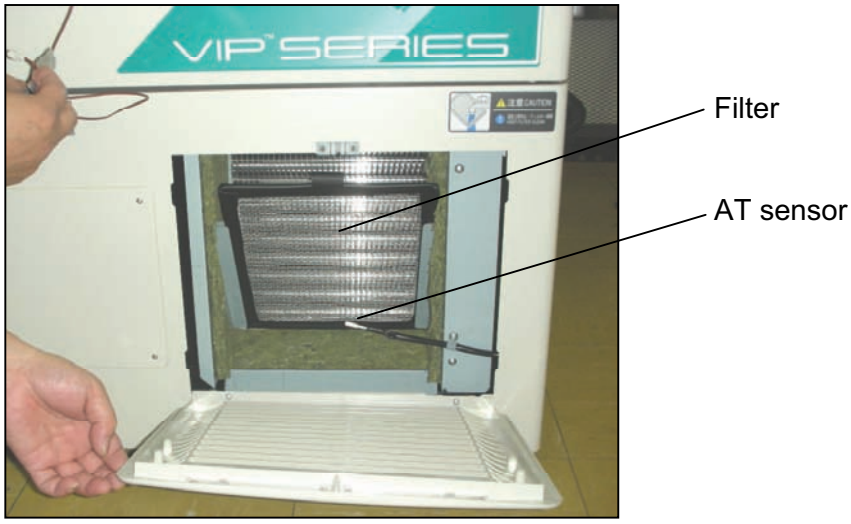


<Switching power supply>

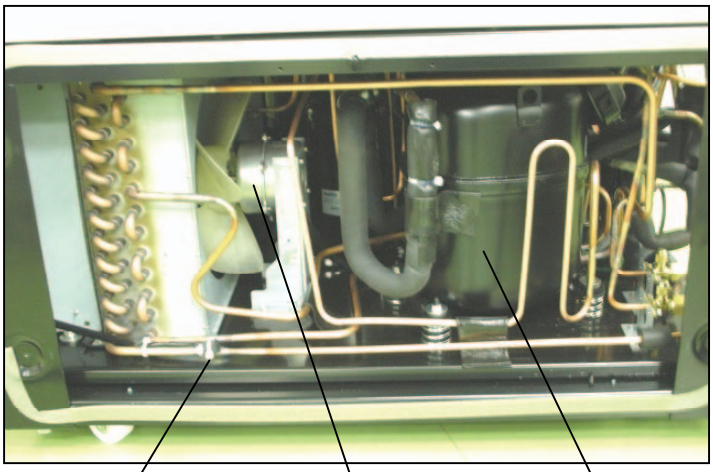

Control panel
Door latch
Handle
PCB BOX


<Electric BOX>
Comp. H relay
Remote alarm terminal
12P terminal
Battery switch
Starting relay L
Temp. control relay
Power switch
Power transformer
Starting relay H
Starting cap. L
Running cap. H
Heater relay
Running cap. L
Starting cap. H
Temp. control PCB
Switching power supply

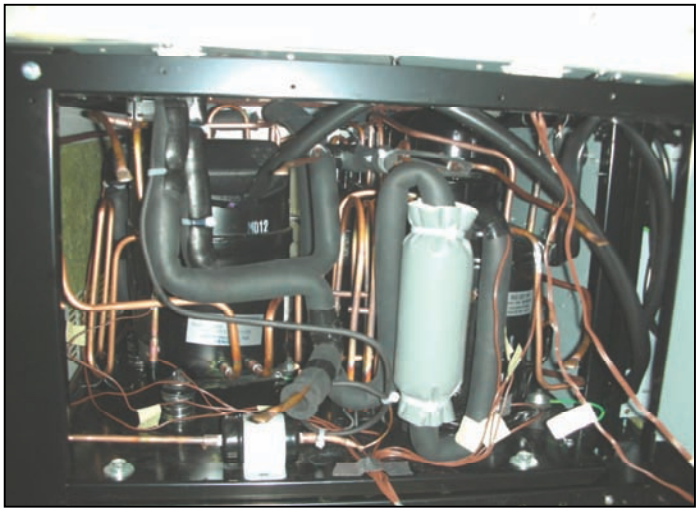
<Lower front>



<Lower right side>

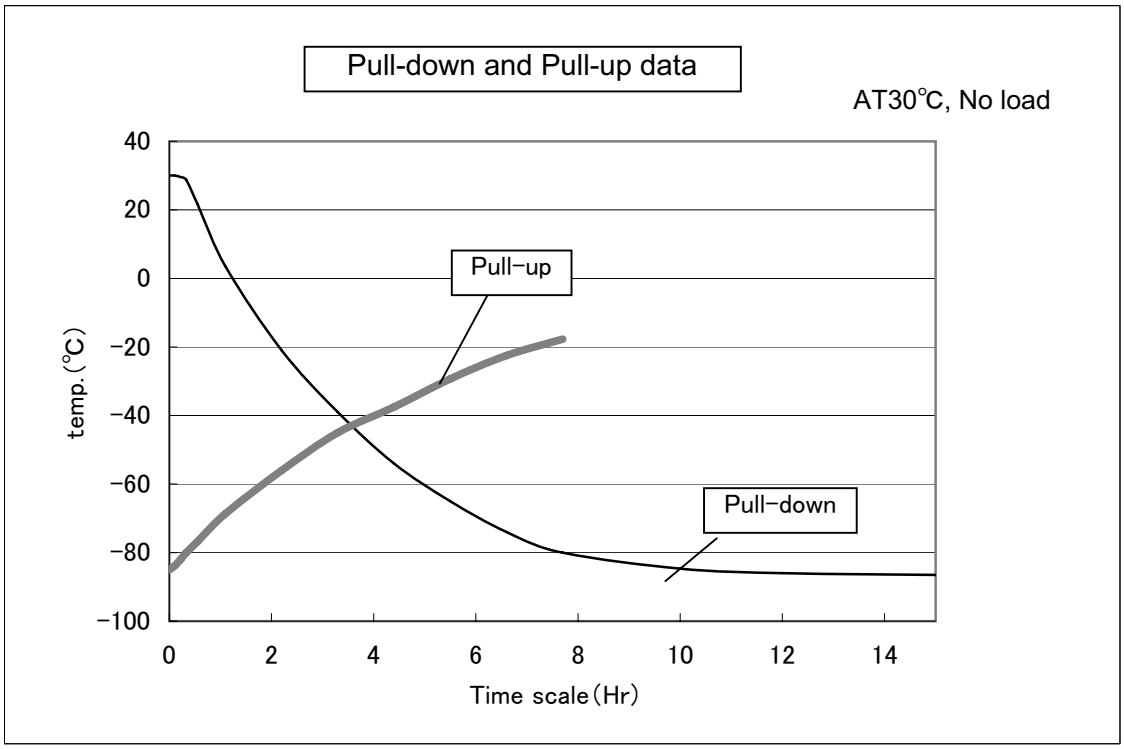


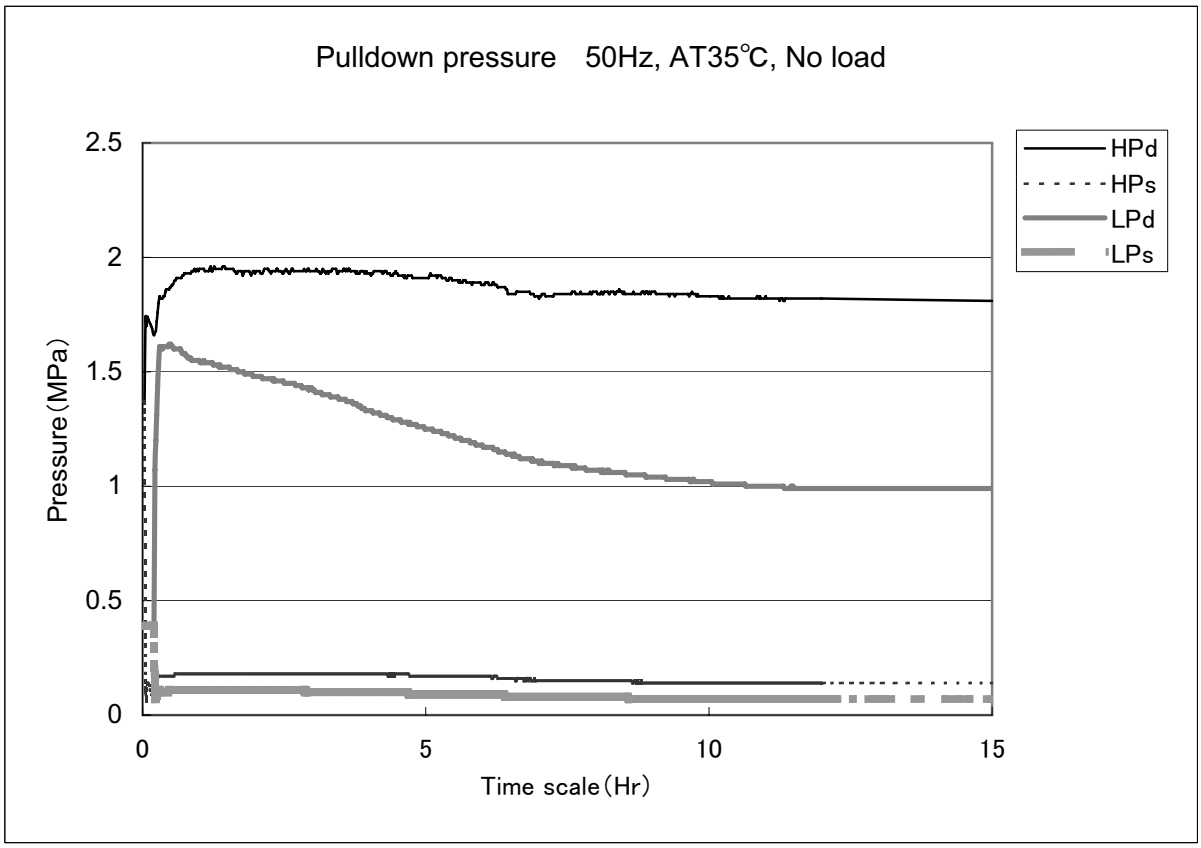
<Lower back side>

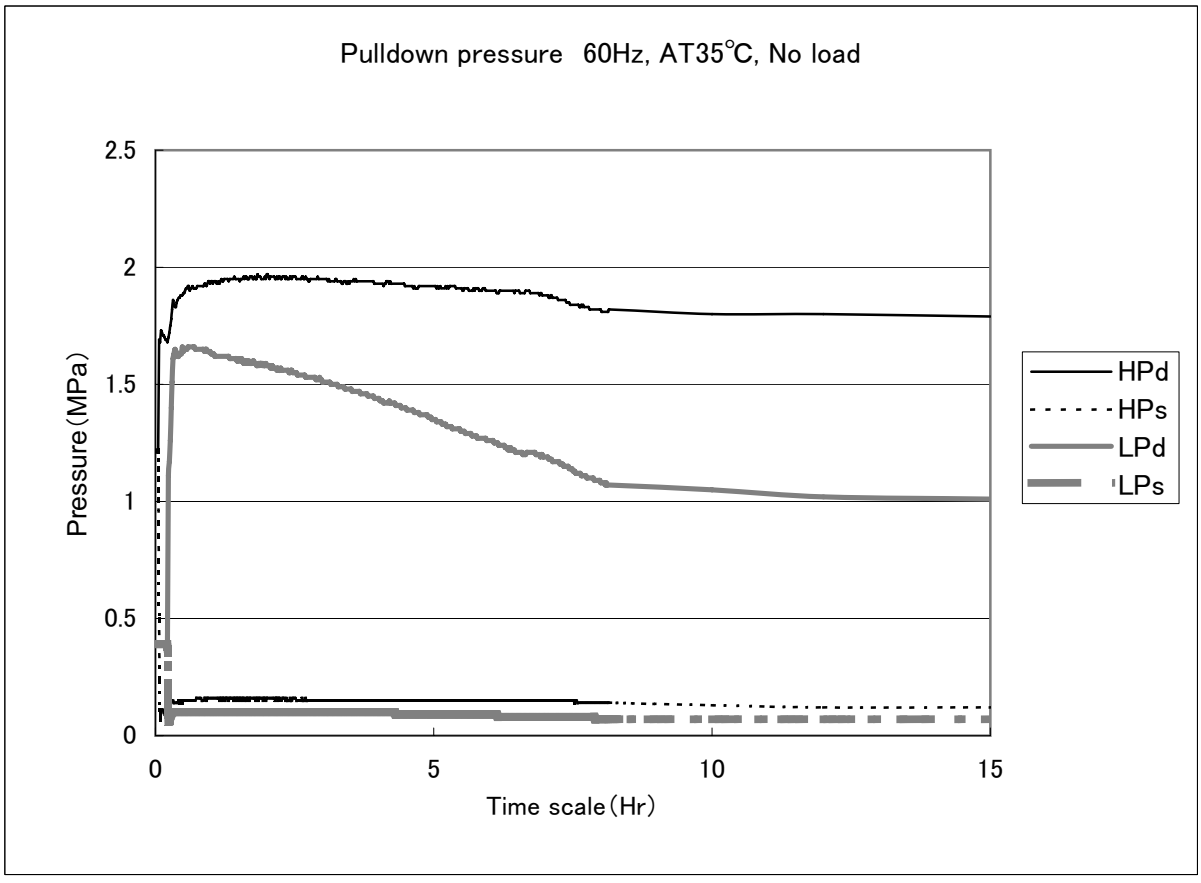


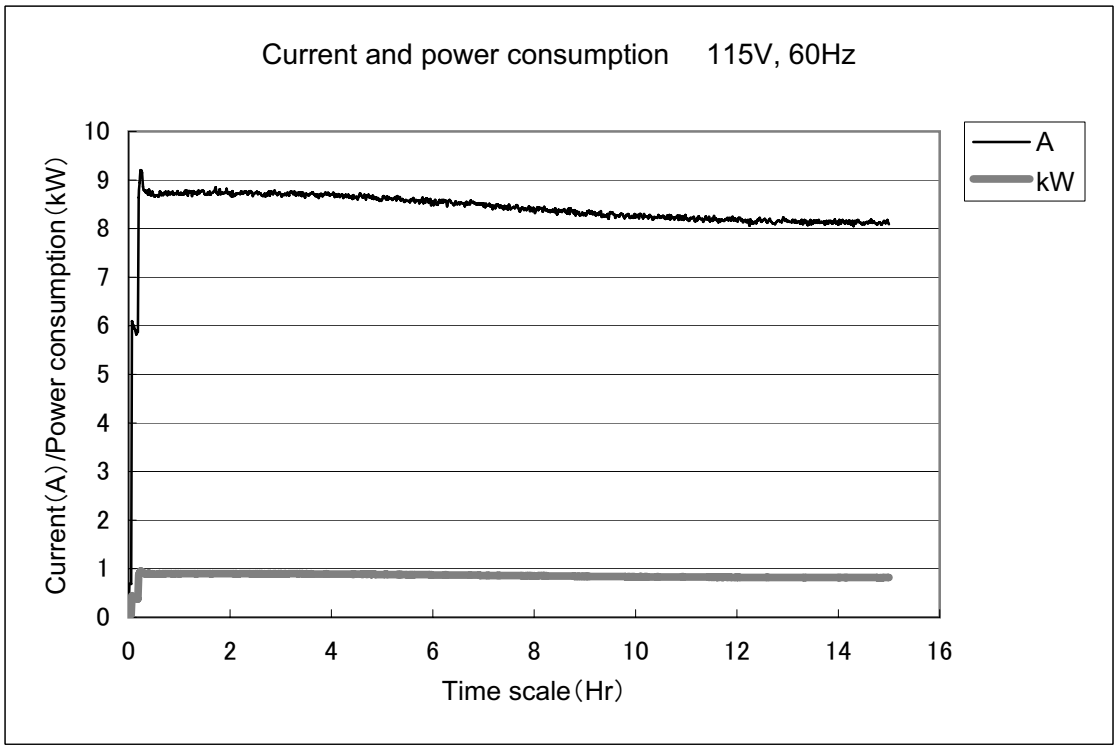
Test data

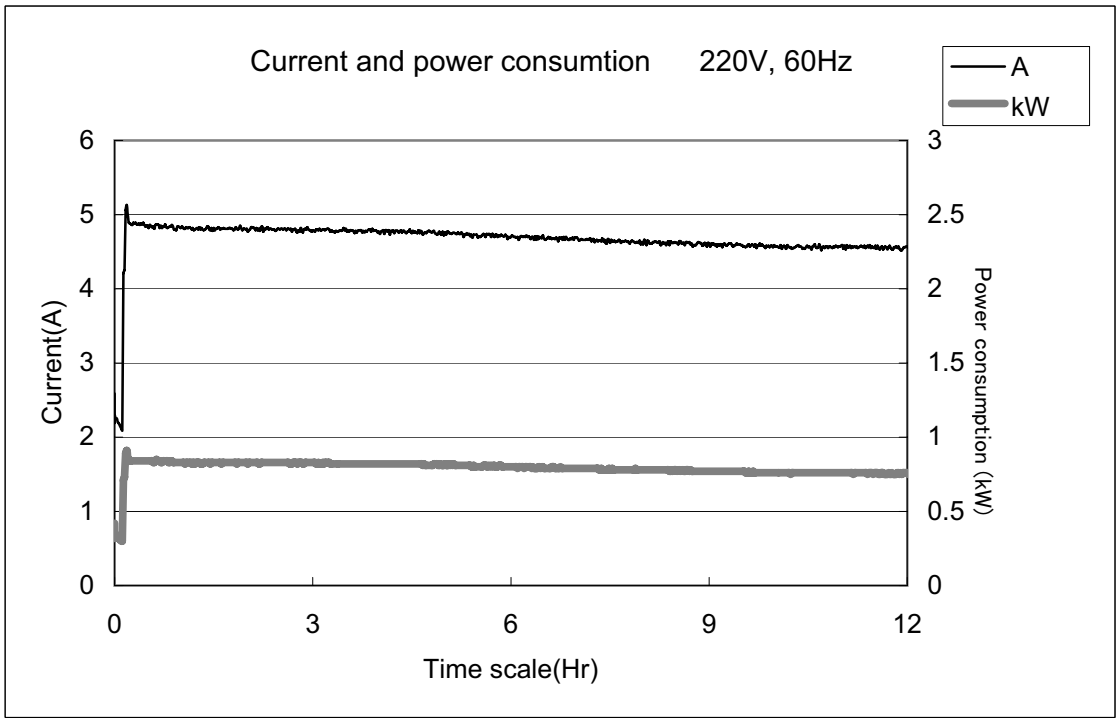
※All the data are the reference only.

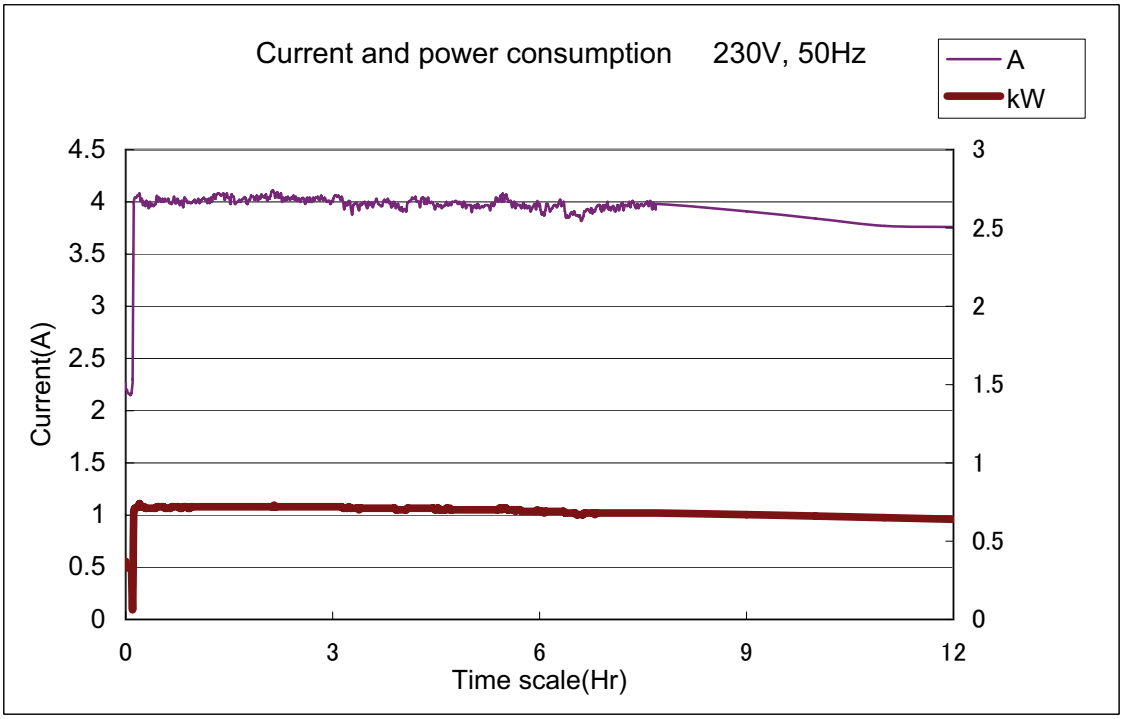


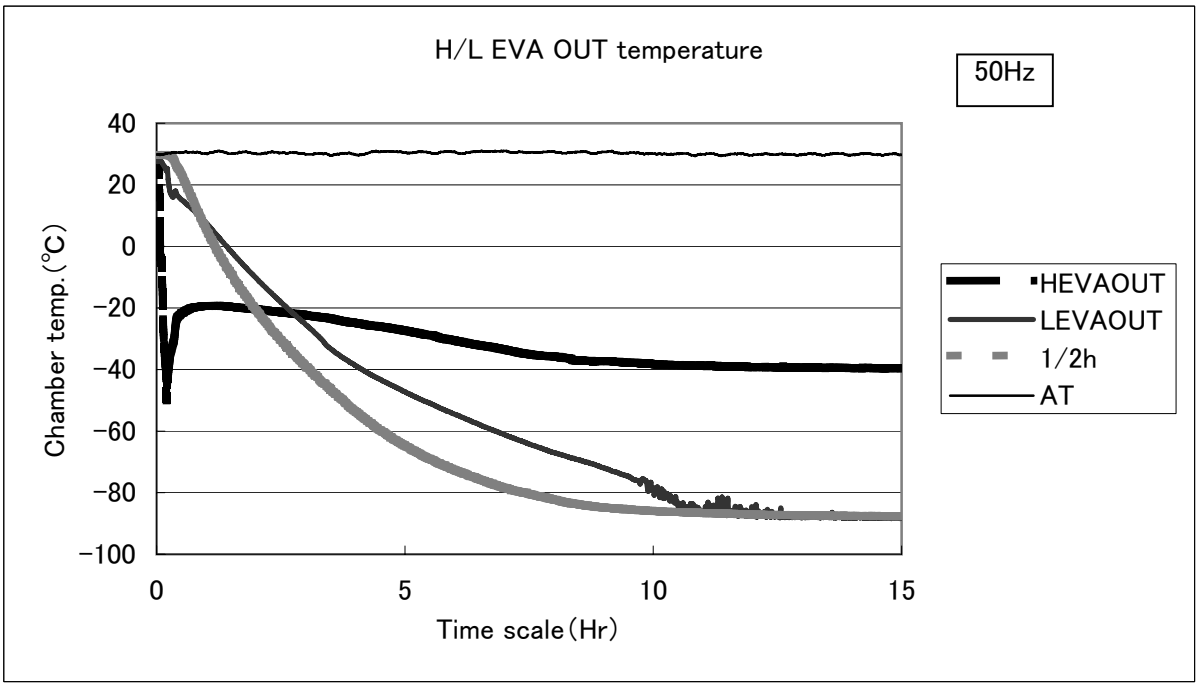

Pulldown pressure 50Hz, AT35℃, No load
Pressure (MPa)
2.5
2
1.5
1
0.5
0
0
5
10
15
Time scale (Hr)
HPd
HPs
LPd
LPs

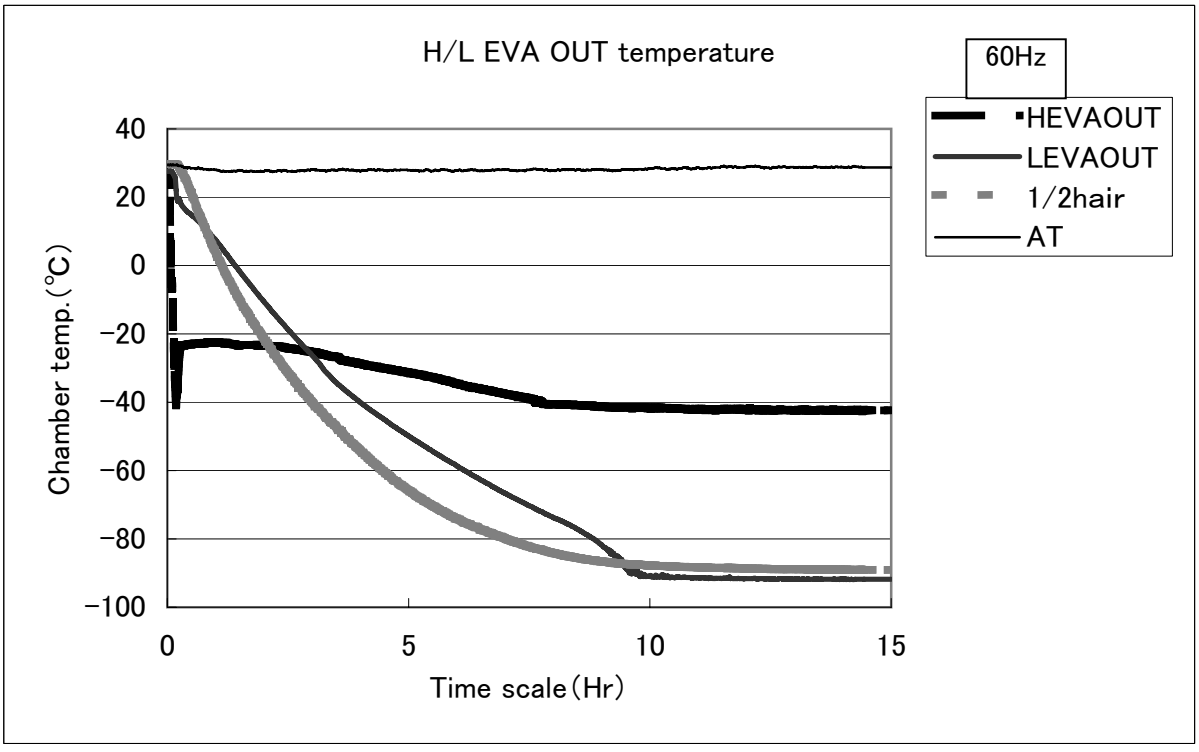

Pulldown pressure 60Hz, AT35℃, No load
Pressure (MPa)
2.5
2
1.5
1
0.5
0
0
5
10
15
Time scale (Hr)
HPd
HPs
LPd
LPs


Current and power consumption 115V, 60Hz
Current(A)/Power consumption(kW)
Time scale(Hr)
A
kW
0
1
2
3
4
5
6
7
8
9
10
0
2
4
6
8
10
12
14
16


Current and power consumtion 220V, 60Hz
Current(A)
Power consumption (kW)
Time scale(Hr)
A
kW
0
1
2
3
4
5
6
0
0.5
1
1.5
2
2.5
3
0
3
6
9
12

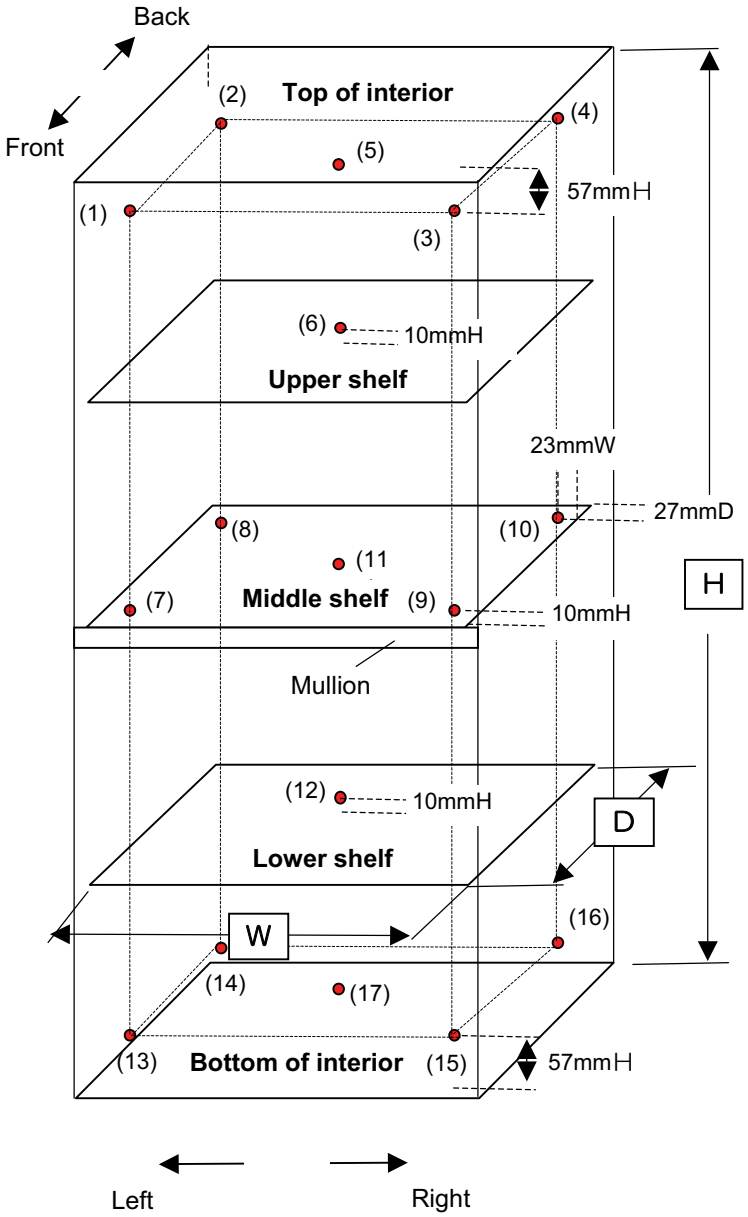

Current and power consumption 230V, 50Hz
A
kW
Current(A)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
3
2.5
2
1.5
1
0.5
0
0
3
6
9
12
Time scale(Hr)


H/L EVA OUT temperature
50Hz
40
20
0
−20
−40
−60
−80
−100
Chamber temp.(℃)
0
5
10
15
Time scale(Hr)
HEVAOUT
LEVAOUT
1/2h
AT


H/L EVA OUT temperature
60Hz
40
20
0
−20
−40
−60
−80
−100
Chamber temp.(℃)
0
5
10
15
Time scale(Hr)
HEVAOUT
LEVAOUT
1/2hair
AT

<17points temperature uniformity>

Note) These data are the reference only.



Upper are measuring points

(1)~(4): 57mm(H) from the top of interior
27mm(D) and 23mm(W) from each corners on Middle shelf

(5): 57mm(H) from the top of interior

(6): 10mm(H) from Upper shelf

Middle area mesuring points

(7)~(10): 10mm(H), 27mm(D), 23mm(W) from each corners on Middle shelf

(11): 10mm(H) from Middle shelf

Bottom area measuring points

(12): 10mm(H) from Lower shelf

(13)~(16): 57mm(H) from Bottom of interior
27mm(D) and 23mm(W) from each corner on Middle shelf

(17): 57mm(H) from Bottom of interior

Condition: SV -80℃, AT30℃, 50Hz

	Measured points	MAX	MIN	Middle of cycle	Differential
Upper area	(1) Left front	-73.9	-78.8	-76.35	±2.45
	(2) Left back	-74.7	-81.1	-77.90	±3.20
	(3) Right front	-74.1	-78.8	-76.45	±2.35
	(4) Right back	-74.6	-80.7	-77.65	±3.05
	(5) Center	-73.1	-78.4	-75.75	±2.65
	(6) Center on uppper shelf	-76.8	-78.6	-77.70	±0.90
Middle area	(7) Left front	-73.9	-76.4	-75.15	±1.25
	(8) Left back	-76.9	-81.2	-79.05	±2.15
	(9) Right front	-76.7	-80.8	-78.75	±2.05
	(10) Right back	-74.4	-77.5	-75.95	±1.55
	(11) Center on Middle shelf	-76.7	-79.3	-78.00	±1.30
Bottom area	(12) Center on lower shelf	-74.3	-75.8	-75.05	±0.75
	(13) Left front	-73.0	-75.5	-74.25	±1.25
	(14) Left back	-73.0	-76.3	-74.65	±1.65
	(15) Right front	-72.7	-75.5	-74.10	±1.40
	(16) Right back	-73.0	-75.2	-74.10	±1.10
	(17) Center	-73.4	-76.7	-75.05	±1.65
17points measured		-72.7	-81.2	-76.23	
		Max	Min	Ave	

Condition: SV -70℃, AT30℃, 50Hz

	Measured points	MAX	MIN	Middle of cycle	Differential
Upper area	(1) Left front	-66.5	-71.6	-69.10	±2.55
	(2) Left back	-67.9	-75.0	-71.50	±3.55
	(3) Right front	-66.5	-72.3	-69.40	±2.90
	(4) Right back	-67.4	-74.4	-70.90	±3.50
	(5) Center	-66.0	-71.2	-68.60	±2.60
	(6) Center on uppper shelf	-68.6	-70.9	-69.80	±1.15
Middle area	(7) Left front	-64.3	-66.9	-65.60	±1.30
	(8) Left back	-68.4	-73.0	-70.70	±2.30
	(9) Right front	-68.2	-72.4	-70.30	±2.10
	(10) Right back	-65.1	-68.0	-66.60	±1.45
	(11) Center on Middle shelf	-67.4	-70.5	-69.00	±1.55
Bottom area	(12) Center on lower shelf	-62.7	-64.1	-63.40	±0.70
	(13) Left front	-61.7	-63.8	-62.80	±1.05
	(14) Left back	-62.8	-65.6	-64.20	±1.40
	(15) Right front	-61.8	-63.6	-62.70	±0.90
	(16) Right back	-61.7	-64.0	-62.90	±1.15
	(17) Center	-62.4	-65.4	-63.90	±1.50
17points measured		-61.7	-75.0	-67.14	
		Max	Min	Ave	

Condition: SV -80℃, AT20℃, 50Hz

	Measured points	MAX	MIN	Middle of cycle	Differential
Upper area	(1) Left front	-75.7	-79.6	-77.65	±1.95
	(2) Left back	-76.6	-82.0	-79.30	±2.70
	(3) Right front	-75.7	-80.2	-77.95	±2.25
	(4) Right back	-76.3	-81.9	-79.10	±2.80
	(5) Center	-75.2	-79.3	-77.25	±2.05
	(6) Center on uppper shelf	-77.9	-79.4	-78.65	±0.75
Middle area	(7) Left front	-74.5	-76.9	-75.70	±1.20
	(8) Left back	-77.9	-82.0	-79.95	±2.05
	(9) Right front	-77.8	-81.5	-79.65	±1.85
	(10) Right back	-75.3	-78.1	-76.70	±1.40
	(11) Center on Middle shelf	-77.0	-79.7	-78.35	±1.35
Bottom area	(12) Center on lower shelf	-74.0	-75.0	-74.50	±0.50
	(13) Left front	-72.7	-74.6	-73.65	±0.95
	(14) Left back	-73.1	-75.7	-74.10	±1.30
	(15) Right front	-72.6	-74.7	-73.65	±1.05
	(16) Right back	-72.6	-74.8	-73.70	±1.10
	(17) Center	-72.1	-75.7	-74.20	±1.50
17points measured		-72.1	-82.0	-76.71	
		Max	Min	Ave	

Condition: SV -70℃, AT20℃, 50Hz

	Measured points	MAX	MIN	Middle of cycle	Differential
Upper area	(1) Left front	-66.7	-71.9	-69.30	±2.60
	(2) Left back	-68.4	-75.3	-71.85	±3.45
	(3) Right front	-67.1	-72.8	-69.95	±2.85
	(4) Right back	-68.0	-74.8	-71.40	±3.40
	(5) Center	-66.5	-71.5	-69.00	±2.50
	(6) Center on uppper shelf	-68.7	-70.8	-69.75	±1.05
Middle area	(7) Left front	-64.6	-67.0	-65.80	±1.20
	(8) Left back	-68.5	-73.0	-70.75	±2.25
	(9) Right front	-68.2	-72.3	-70.25	±2.05
	(10) Right back	-65.3	-68.2	-66.75	±1.45
	(11) Center on Middle shelf	-67.4	-70.0	-68.70	±1.30
Bottom area	(12) Center on lower shelf	-62.7	-63.7	-63.20	±0.50
	(13) Left front	-61.7	-63.3	-62.50	±0.80
	(14) Left back	-62.9	-65.2	-64.05	±1.15
	(15) Right front	-61.6	-63.4	-62.50	±0.90
	(16) Right back	-61.7	-63.6	-62.65	±0.95
	(17) Center	-62.3	-64.5	-63.40	±1.10
17points measured		-61.6	-75.3	-67.16	
		Max	Min	Ave	

Condition: SV -80℃, AT30℃, 60Hz

	Measured points	MAX	MIN	Middle of cycle	Differential
Upper area	(1) Left front	-74.3	-78.7	-76.50	±2.20
	(2) Left back	-75.5	-80.4	-77.95	±2.45
	(3) Right front	-74.7	-79.1	-76.90	±2.20
	(4) Right back	-75.6	-80.9	-78.25	±2.65
	(5) Center	-75.0	-79.8	-77.40	±2.40
	(6) Center on uppper shelf	-77.7	-79.4	-78.55	±0.85
Middle area	(7) Left front	-75.3	-77.7	-76.50	±1.20
	(8) Left back	-78.0	-81.9	-79.95	±1.95
	(9) Right front	-75.2	-78.0	-76.60	±1.40
	(10) Right back	-77.9	-81.6	-79.75	±1.85
	(11) Center on Middle shelf	-76.9	-79.1	-78.00	±1.10
Bottom area	(12) Center on lower shelf	-72.8	-75.0	-73.90	±1.10
	(13) Left front	-74.6	-76.0	-75.30	±0.70
	(14) Left back	-73.3	-76.2	-74.75	±1.45
	(15) Right front	-72.9	-75.5	-74.20	±1.30
	(16) Right back	-73.2	-76.4	-74.80	±1.60
	(17) Center	-73.8	-76.1	-74.95	±1.15
17points measured		-72.8	-81.9	-76.72	
		Max	Min	Ave	

Condition: SV -70℃, AT30℃, 60Hz

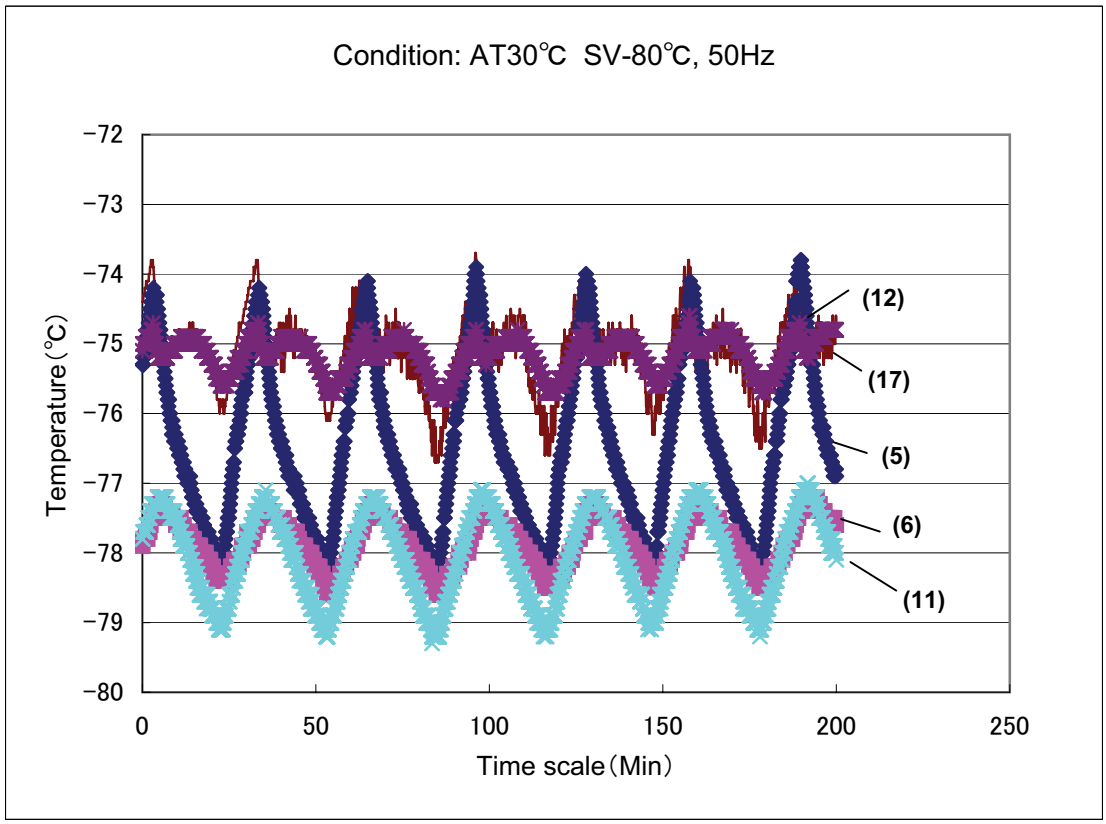
	Measured points	MAX	MIN	Middle of cycle	Differential
Upper area	(1) Left front	-66.4	-73.0	-69.70	±3.30
	(2) Left back	-67.7	-75.7	-71.70	±4.00
	(3) Right front	-66.9	-73.5	-70.20	±3.30
	(4) Right back	-67.8	-75.9	-71.85	±4.05
	(5) Center	-67.1	-74.7	-70.90	±3.80
	(6) Center on uppper shelf	-69.5	-73.2	-71.35	±1.85
Middle area	(7) Left front	-65.9	-70.0	-69.75	±2.05
	(8) Left back	-69.3	-75.5	-72.40	±3.10
	(9) Right front	-65.8	-69.9	-67.85	±2.05
	(10) Right back	-69.2	-75.3	-72.25	±3.05
	(11) Center on Middle shelf	-67.8	-71.8	-69.80	±2.00
Bottom area	(12) Center on lower shelf	-62.3	-65.0	-63.65	±1.35
	(13) Left front	-64.0	-66.0	-65.00	±1.00
	(14) Left back	-63.3	-66.9	-65.10	±1.80
	(15) Right front	-62.6	-65.4	-64.00	±1.40
	(16) Right back	-62.8	-66.5	-64.65	±1.85
	(17) Center	-63.1	-66.4	-64.75	±1.65
17points measured		-62.3	-75.9	-68.52	
		Max	Min	Ave	

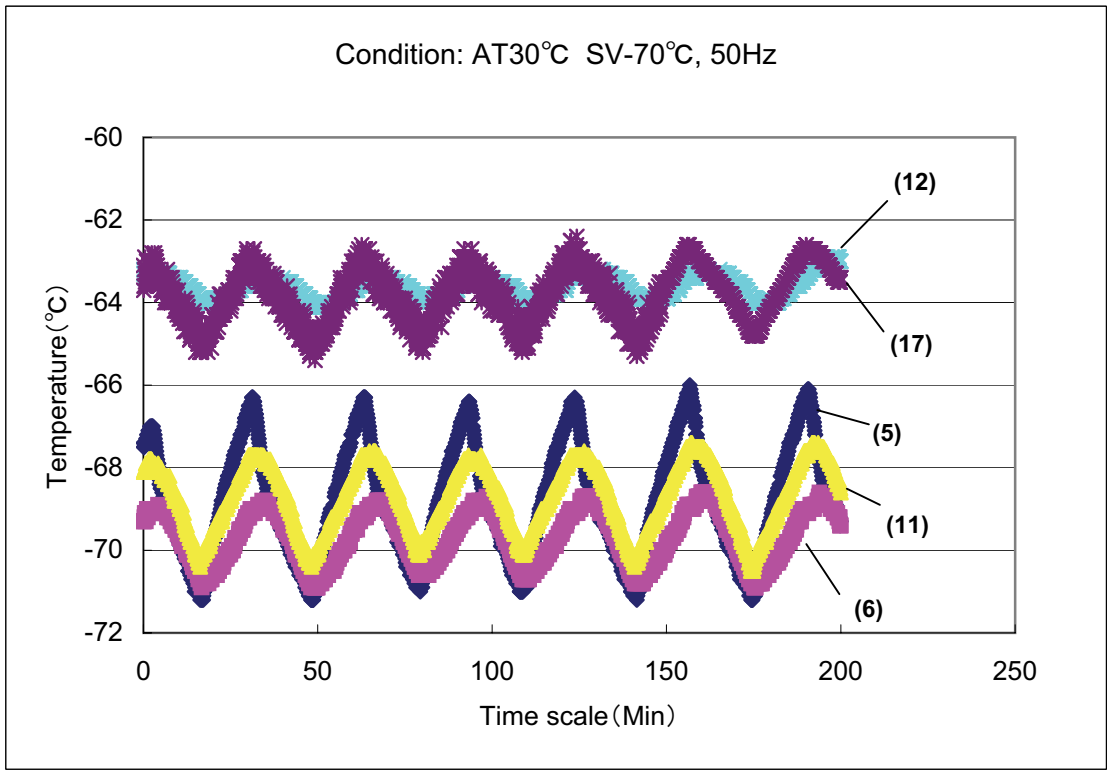
Condition: SV -80℃, AT20℃, 60Hz

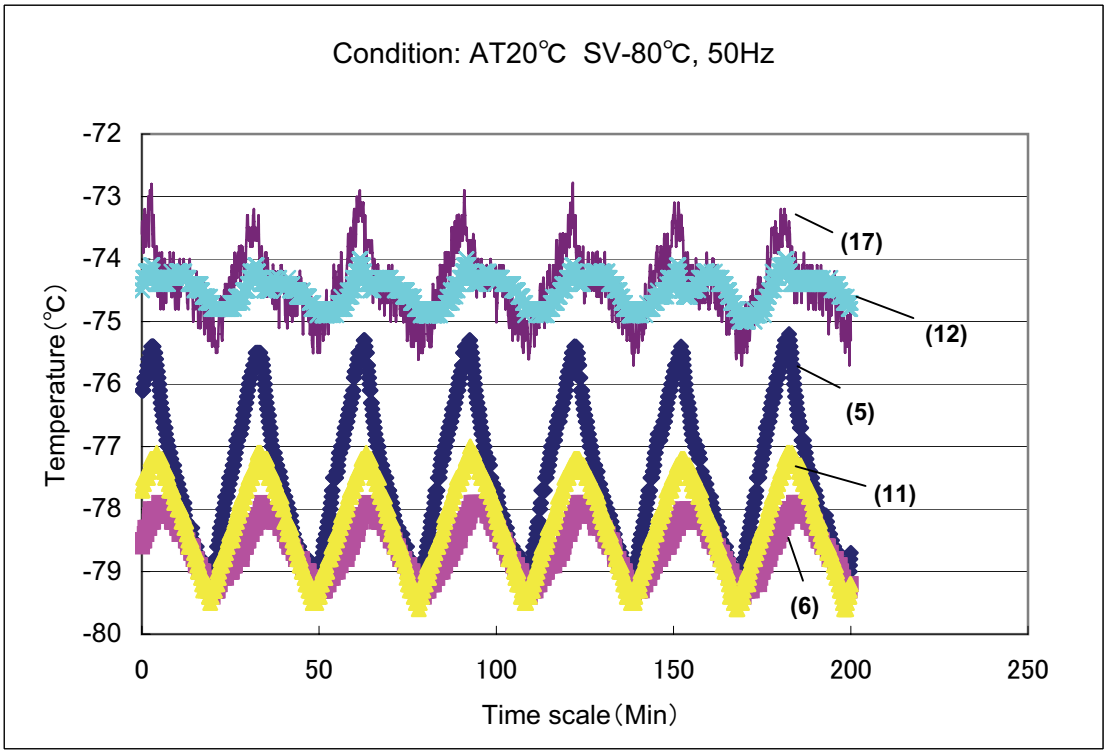
	Measured points	MAX	MIN	Middle of cycle	Differential
Upper area	(1) Left front	-75.3	-79.5	-77.40	±2.10
	(2) Left back	-76.6	-81.5	-79.05	±2.45
	(3) Right front	-75.7	-80.0	-77.85	±2.15
	(4) Right back	-76.5	-81.8	-79.15	±2.65
	(5) Center	-75.8	-80.8	-78.30	±2.50
	(6) Center on uppper shelf	-78.4	-80.1	-79.25	±0.85
Middle area	(7) Left front	-75.7	-78.3	-77.00	±1.30
	(8) Left back	-78.5	-82.4	-80.45	±1.95
	(9) Right front	-75.6	-78.2	-76.90	±1.30
	(10) Right back	-78.4	-82.3	-80.35	±1.95
	(11) Center on Middle shelf	-77.3	-79.5	-78.40	±1.10
Bottom area	(12) Center on lower shelf	-73.1	-75.1	-74.10	±1.00
	(13) Left front	-74.7	-76.0	-75.35	±0.65
	(14) Left back	-73.6	-76.2	-74.90	±1.30
	(15) Right front	-73.1	-75.4	-74.25	±1.15
	(16) Right back	-73.3	-76.4	-74.85	±1.55
	(17) Center	-73.9	-75.9	-74.90	±1.00
17points measured		-73.1	-82.4	-77.20	
		Max	Min	Ave	

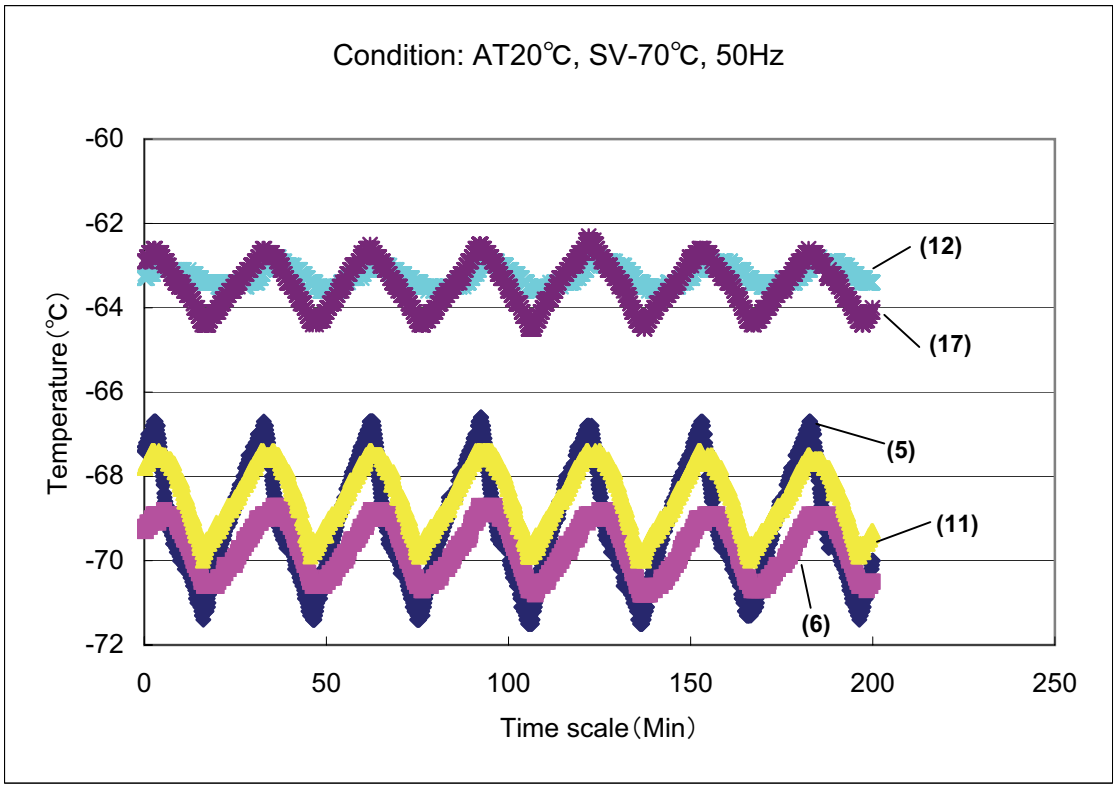
Condition: SV -70℃, AT20℃, 60Hz

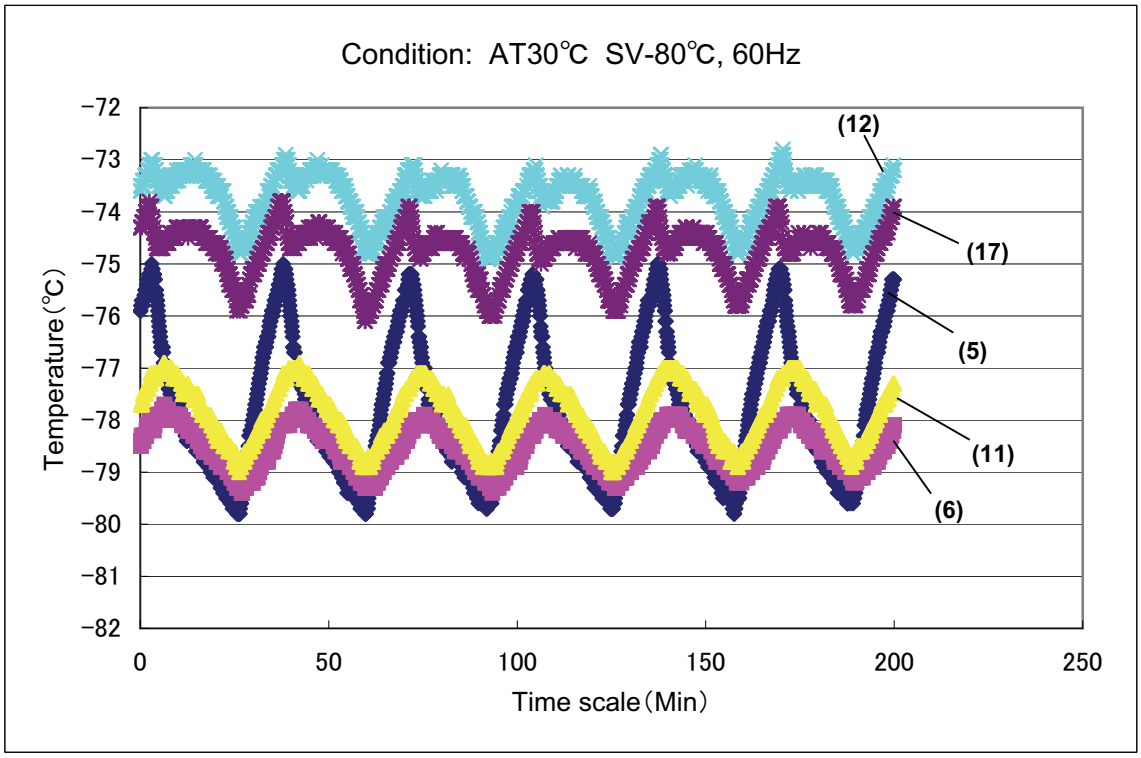
	Measured points	MAX	MIN	Middle of cycle	Differential
Upper area	(1) Left front	-66.8	-73.3	-70.05	±3.25
	(2) Left back	-68.1	-75.8	-71.95	±3.85
	(3) Right front	-67.3	-73.8	-70.55	±3.25
	(4) Right back	-68.2	-76.3	-72.25	±4.05
	(5) Center	-67.6	-75.2	-71.40	±3.80
	(6) Center on uppper shelf	-69.5	-73.2	-71.35	±1.85
Middle area	(7) Left front	-66.2	-69.8	-68.00	±1.80
	(8) Left back	-69.2	-75.5	-72.35	±3.15
	(9) Right front	-65.9	-69.7	-67.80	±1.90
	(10) Right back	-69.3	-75.1	-72.20	±2.90
	(11) Center on Middle shelf	-67.9	-71.7	-69.80	±1.90
Bottom area	(12) Center on lower shelf	-62.7	-65.2	-63.95	±1.25
	(13) Left front	-64.4	-66.2	-65.30	±0.90
	(14) Left back	-63.7	-67.1	-65.40	±1.70
	(15) Right front	-62.8	-65.4	-64.10	±1.30
	(16) Right back	-63.1	-66.7	-64.90	±1.80
	(17) Center	-63.5	-66.6	-65.05	±1.55
17points measured		-62.7	-76.3	-68.61	
		Max	Min	Ave	

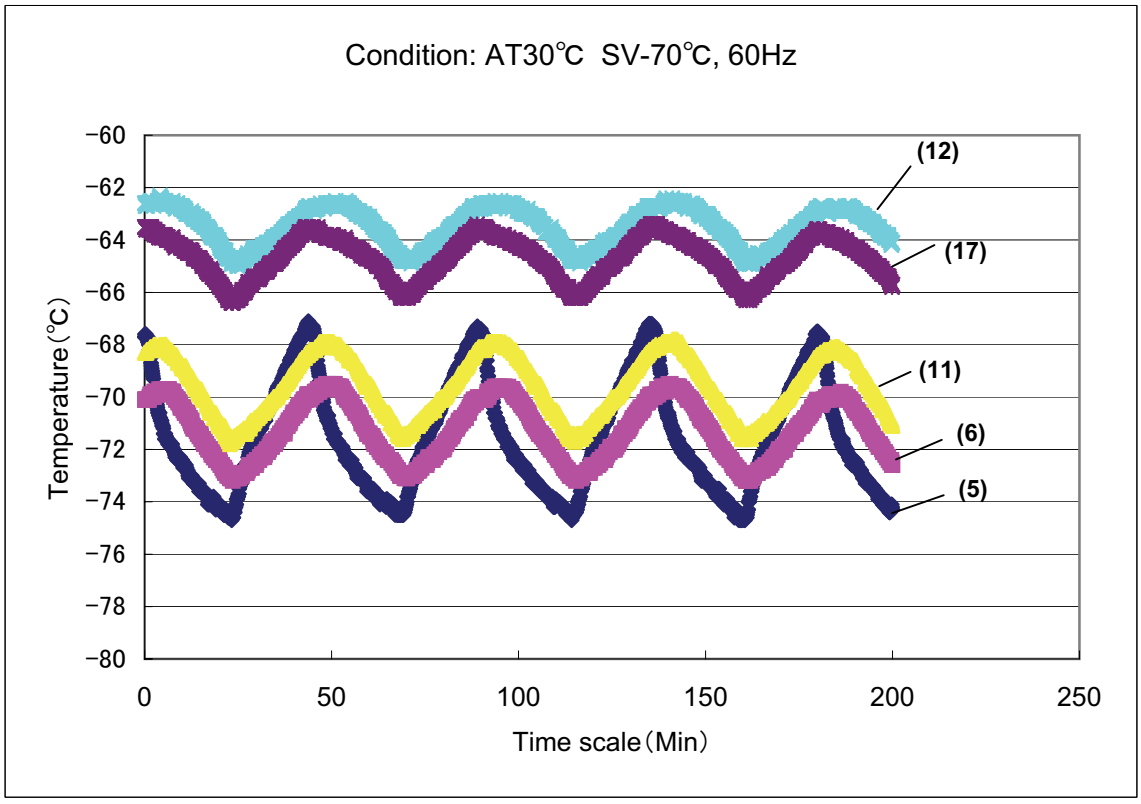

Condition: AT30℃ SV-80℃, 50Hz
−72
−73
−74
−75
−76
−77
−78
−79
−80
Temperature(℃)
0
50
100
150
200
250
Time scale(Min)
(12)
(17)
(5)
(6)
(11)

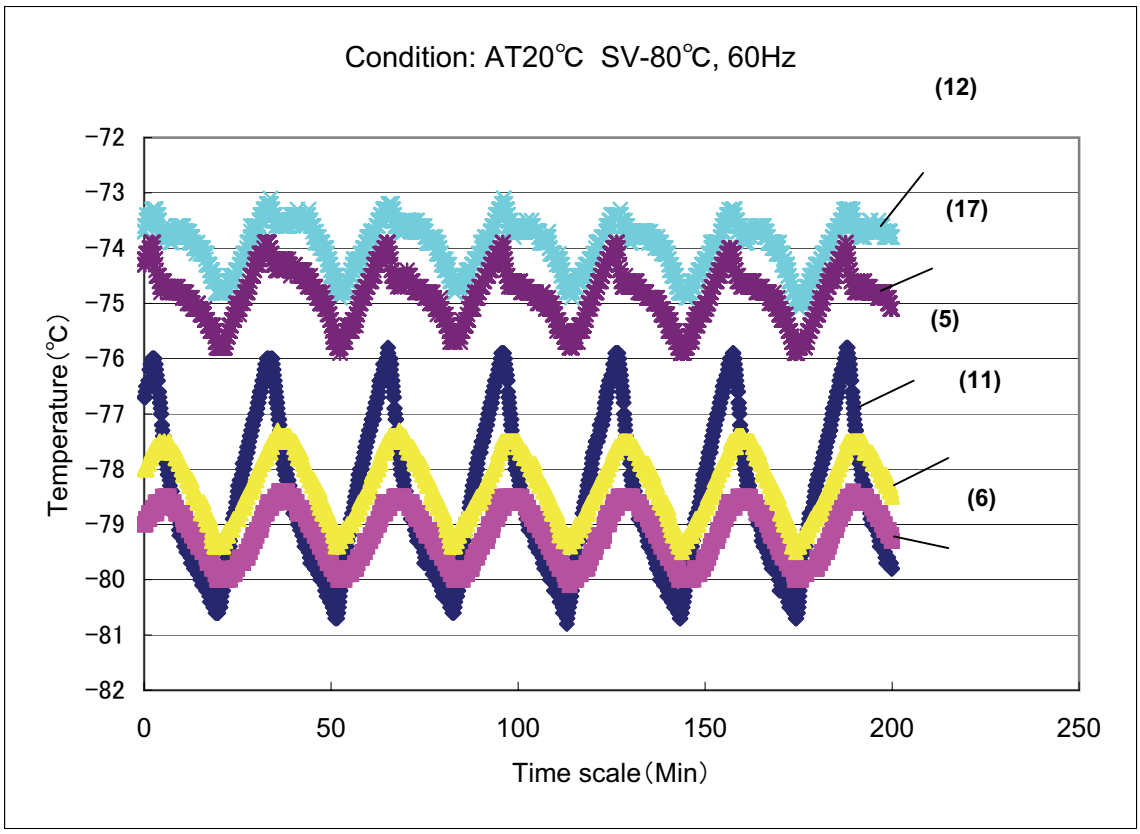

Condition: AT30℃ SV-70℃, 50Hz
-60
-62
-64
-66
-68
-70
-72
Temperature(℃)
0
50
100
150
200
250
Time scale(Min)
(12)
(17)
(5)
(11)
(6)

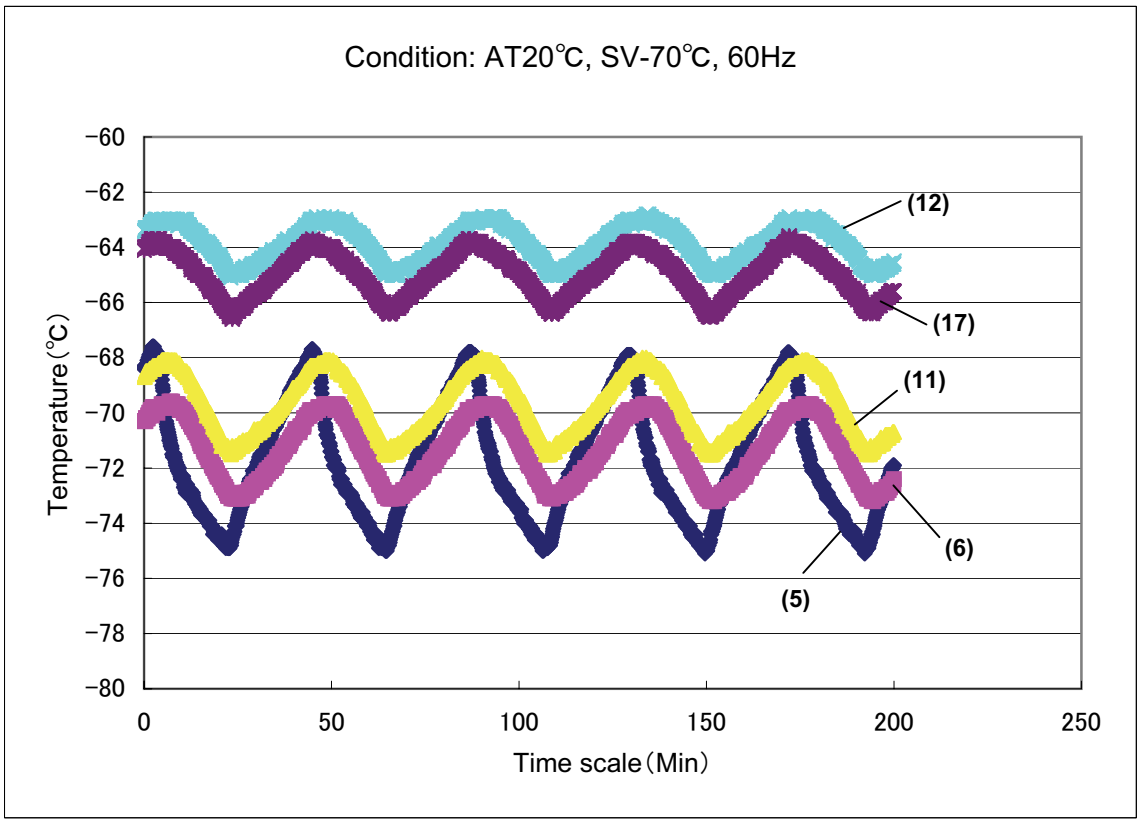

Condition: AT20℃ SV-80℃, 50Hz
-72
-73
-74
-75
-76
-77
-78
-79
-80
Temperature (℃)
0
50
100
150
200
250
Time scale (Min)
(17)
(12)
(5)
(11)
(6)


Condition: AT20℃, SV-70℃, 50Hz
-60
-62
-64
-66
-68
-70
-72
Temperature (℃)
0
50
100
150
200
250
Time scale (Min)
(12)
(17)
(5)
(11)
(6)


Condition: AT30℃ SV-80℃, 60Hz
Temperature (℃)
−72
−73
−74
−75
−76
−77
−78
−79
−80
−81
−82
0
50
100
150
200
250
Time scale (Min)
(12)
(17)
(5)
(11)
(6)


Condition: AT30℃ SV-70℃, 60Hz
Temperature (℃)
−60
−62
−64
−66
−68
−70
−72
−74
−76
−78
−80
0
50
100
150
200
250
Time scale (Min)
(12)
(17)
(11)
(6)
(5)


Condition: AT20℃ SV-80℃, 60Hz
(12)
(17)
(5)
(11)
(6)
−72
−73
−74
−75
−76
−77
−78
−79
−80
−81
−82
Temperature(℃)
0
50
100
150
200
250
Time scale(Min)


Condition: AT20℃, SV-70℃, 60Hz
(12)
(17)
(11)
(6)
(5)
−60
−62
−64
−66
−68
−70
−72
−74
−76
−78
−80
Temperature(℃)
0
50
100
150
200
250
Time scale(Min)

<Power consumption data>

(Unit: KWh/day)

Power source	115V60Hz		230V50Hz		220V60Hz	
AT / SV	20℃	30℃	20℃	30℃	20℃	30℃
-70℃	10.7	12.5	8.4	9.8	9.8	11.3
-80℃	12.0	14.3	9.2	11.0	10.9	13.1

<Maximum heat emission data>

(Unit: kJ)

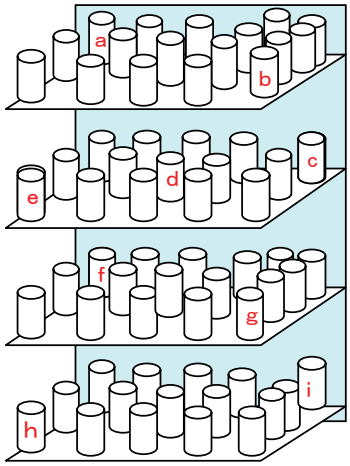
Power source	115V60Hz	220V50Hz	230V50Hz	240V50Hz	220V60Hz
	3420	3024	2664	2808	3204

* These data are the reference only.

Sample load test

Load: Bottle of water (500ml) x 110（55L in total）

* Following data is the reference only



Top: 500ml x 27

Upper: 500ml x 28 bottles

Lower: 500ml x 27 bottles

Bottom: 500ml x 28 bottles